

LITTER SIZE, BIRTH WEIGHT, AND EARLY GROWTH RATE OF MICE (*MUS MUSCULUS*)

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FOUR CHARTS

The following work was done in the Department of Genetics of the Carnegie Institution, Cold Spring Harbor, Long Island, during the summer of 1922, at the suggestion of Dr. C. C. Little, to whom thanks are due for helpful advice and the use of his material. Dr. W. E. Castle also has kindly given many helpful suggestions concerning the analysis of the data. Credit is due Miss H. Ulman for valuable aid in the mechanical operations of weighing and recording.

The mice involved in this experiment were from the laboratory stock of Doctor Little and included the litters born from the 21st of June to the 1st of August, 1922, inclusive.

The object of the experiment was to secure individual growth curves for the mice from the time of birth up to the time of weaning, three weeks after birth.

The method of procedure was as follows: All pens containing pregnant mice were carefully gone over daily by Doctor Little or his assistants and all new litters recorded. The record of these was then handed to me. This record included all young born before 9 o'clock in the morning. In a few instances, where parturition was not complete by that hour, the litter was weighed and recorded later in the day. When the record of the litters born had been received, each litter was examined separately and each individual was marked and then weighed.

Many different methods of marking were tried out before a satisfactory one was found. Staining with various dyes

was found not to be satisfactory, as the stains were either worn off or licked off by the mother. Where the stain was sufficient to stay for a day or more, it was lost soon after, due to the shedding of the epidermis and the growth of the hair. Finally, branding with a hot iron was tried and found to be very satisfactory. In fact, so much so, that several months later Doctor MacDowell, who took over many of Doctor Little's mice, became greatly puzzled to find irregular spots of aberrant color occurring on the pelage of some of the mice, which were later found to have resulted from the branding.

The number of each individual was indicated by branding at a certain place on the body. Zero of each litter did not receive a brand. One, two, and three were branded, respectively, on the left shoulder, left rib, and left hip; four, five, and six were branded on the right shoulder, rib, and hip; seven, eight, and nine between the shoulders, the middle of the back, and at the base of the tail; ten, eleven, and twelve were at first branded in three successive positions on the tail, but this was later given up as sometimes the young would lose their tails, so that for these higher numbers double brands were made, on two of the regular positions. The branding was done with a fine entomological scalpel, the tip of which had been tempered and bent at right angles. This gave a small flat surface which could be touched to the skin without danger of injuring too large a surface. The scalpel was heated almost to the red hot point on an alcohol lamp and the mouse was quickly touched at the required spot. In nearly all cases the brand healed within twenty-four hours and left a clean scar, which, of course, remained visible throughout the life of the mouse. Frequently, as the mouse grew and hair covered the body, the brand became covered, but it could always be found by parting the hair. To facilitate identification, after the second week the hair was cut around the scar, so as to save the time in hunting the brand. Thus every individual in the experiment retained its identity until it was weaned or mated.

The experiment in this particular report included 106 litters containing over 700 mice.

The young were weighed every other day—that is, at two-day intervals. Each individual was given a card on which was recorded the weights, date of birth, litter number, the number of dam, and also the total number in each litter, the number of generations of brother-and-sister matings and any other peculiarity or abnormality. As any other interesting condition developed, it was also recorded.

Earlier writers, Cuénot and Schultze in mice, and Cuénot ('99), King ('18), King and Stotsenburg ('15) in rats, have noted that in these rodents the sex ratio shows an excess of males varying from 106 to 110.9 males to 100 females in mice, and from 104.6 to 107.5 males to 100 females in the rat. King ('24) concludes that $105.2 : 100 \pm 2.00$ is probably the normal for albino rats, and the average for all strains of *Mus norvegicus* is 105.7 males to 100 females ± 1.35 .

In this experiment there were 324 males and 328 females, or a ratio of 98.78 males to 100 females ± 5.21 . The sex in every case was recorded at the first weighing and was later checked on the ninth or eleventh day. As this experiment included litters born during a relatively short length of time, this ratio may not, and probably does not, represent the normal for extended periods of time or larger populations.

The size of the litters shows considerable variation, the number in each litter varying from two to twelve. The general average, however, of the 106 litters is $7.4 \pm .14$. The size of litters with the highest frequency being six, seven, eight, nine, and ten; these size litters containing 79 per cent of all the individuals (table 1 and fig. 1).

In computing mortality statistics, particular care was exercised not to include individuals which showed that death was due to accident or some unnatural cause.

In reckoning time, the day of birth is considered as the first day.

A study of the mortality during growth (table 2) shows just what one might expect—a rather high rate during the first two days, then a slight decrease, followed by a gradual rise up to about the seventeenth day, followed by a rather sudden and decided drop up to weaning. This is shown graphically in figure 2, the data for which are found in table 2. The high mortality for a day or so immediately following birth is to be expected. The gradual rise in mortality during the next two weeks is to be accounted for probably by the crowding of the young and the lack of sufficient nourishment

TABLE 1
Litter size

NUMBER IN EACH LITTER	NUMBER OF LITTERS
2	1
3	4
4	6
5	9
6	17
7	16
8	17
9	18
10	11
11	1
12	6
Average, $7.4 \pm .14$	

TABLE 2
Mortality

DAYS	TOTAL NUMBER	DEATHS	PER CENT
1	678	0	0.0
3	674	10	1.4
5	671	4	0.5
7	656	6	0.8
9	627	16	2.4
11	611	11	1.7
13	579	16	2.6
15	552	24	4.1
17	511	34	6.1
19	496	15	2.9
21	471	4	0.8

for all. This seemed to be the case particularly in the larger litters.

A study of the mortality is interesting also from the fact that the young mice were handled a good deal. On the day of birth the young were first taken out of the cage, examined closely by Doctor Little or his assistants, a little later they were taken to the weighing room, branded, and weighed individually, and then returned. All of this more or less rough treatment and interfering with the duties of the mother did not seem to affect the mortality, because if it were going to have any effect at all it would be most likely to show on the very young; whereas, in reality, the highest mortality rate

was at the end of the second week at a time when the young were certainly old enough and strong enough not to be affected by handling. The highest death rate came about the time the mice were beginning to take care of themselves and

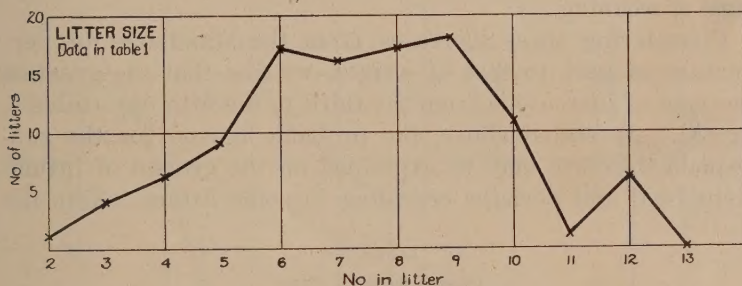


Figure 1

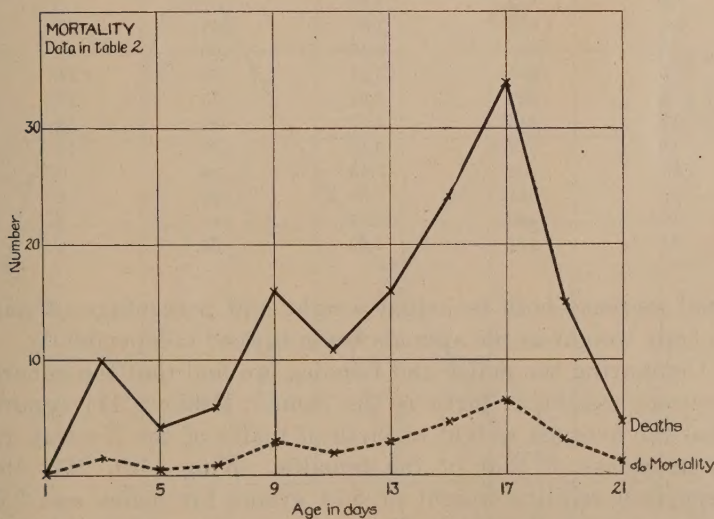


Figure 2

to feed independently. They quickly became accustomed to the change in diet, however, and in a few days were on their feet and began to increase in weight. Stillbirths were not included in any part of the work.

The total average rate of growth is shown graphically in figure 3 (data in table 3). Note the rapid increase in weight daily up to the ninth day, then a gradual lessening up to the seventeenth day, and then a final pick up again, up to the time of weaning.

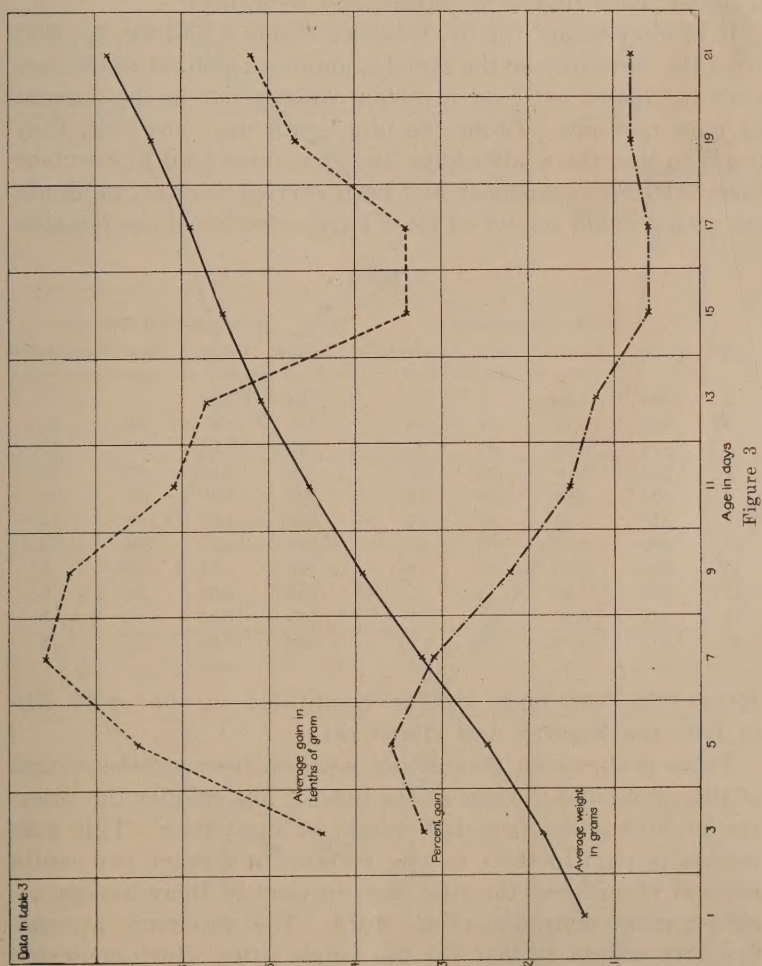
Considering these increases from the standpoint of percentage of gain to that of weight, we find that the greatest per cent of increase is from the third to the fifth day (table 3, fig. 3). As stated above, the probable reason for the subsequent decrease may be explained on the ground of insufficient food and perhaps crowding in some litters. Note the

TABLE 3
Growth weights, totals

DAYS	NO. IND.	WEIGHT	GAIN	PER CENT GAIN
1	678	1.36		
3	674	1.80	.44	32
5	671	2.45	.65	36
7	656	3.21	.76	31
9	627	3.94	.73	22
11	611	4.55	.61	15
13	579	5.12	.57	12
15	552	5.56	.34	6
17	511	5.90	.34	6
19	496	6.37	.47	8
21	471	6.89	.52	8

final increase both in actual weight and percentage of gain to body weight as the animals begin to feed independently.

Comparing the males and females, we find that the general average weight at birth is the same. Miller ('11) reports that the average weight at birth of males of the Norway rat is in excess of that of the females. King ('15, '23) also reports a relative weight of 5.34 grams for males and 5.09 grams for females in the Norway rat, and a relative weight of 4.69 grams and 4.5 grams for the albino rat, male and female, respectively, at birth. This experiment shows a practical equality of weight at birth of the males and females in mice.



The weight recorded as at birth is that after the young have nursed. The actual birth weight would be slightly lower. This weight, however, is taken because it represents a similar condition in all subsequent weighings.

It is interesting to note, however (table 4 and fig. 4), that from the third day on the females maintain a slight advantage over the males not only in actual weight, but in the amount of gain per day. From the nineteenth day, however, they begin to lose their advantage and the males tend to overtake them. If the experiment had been carried further, no doubt the males would sooner or later have outweighed the females.

TABLE 4

GROWTH WEIGHTS MALES					GROWTH WEIGHTS FEMALES				
Days	No. ind.	Weight	Gain	Per cent gain	No. ind.	Weight	Gain	Per cent gain	
1	324	1.38			328	1.38			
3	330	1.79	.41	29	325	1.88	.50	36	
5	328	2.46	.67	37	325	2.52	.63	33	
7	326	3.19	.72	29	320	3.27	.75	29	
9	320	3.89	.70	21	306	4.00	.72	22	
11	313	4.50	.60	15	298	4.60	.60	15	
13	299	5.06	.55	12	278	5.17	.57	12	
15	286	5.49	.43	8	266	5.64	.46	8	
17	266	5.80	.31	5	248	6.00	.35	6	
19	262	6.22	.41	7	239	6.43	.43	7	
21	243	6.78	.56	9	228	7.01	.57	8	

King ('19-'24) finds similar conditions in the early life of both the Norway and albino rat.

Table 5 shows an interesting relation between the weight of the young and the size of the litter. The smaller the litter, the greater is the first-day weight of the young. This may be due in part to their having received a greater per capita amount of milk on the first day, in part to their having received more nourishment in utero. The maximum average first-day weight is that for the single litter which consisted of two young. The first-day weight then decreases steadily, as the number in the litter increases, until it reaches a minimum in litters of nine, beyond which point it is prac-

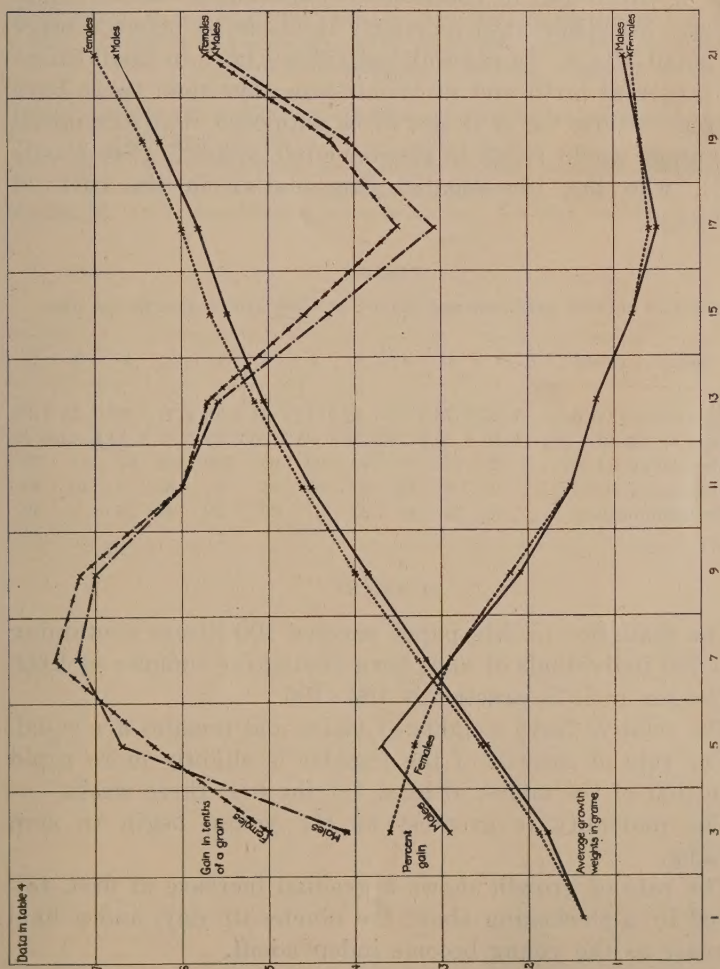


Figure 4

tically stationary. The average weight at twenty-one days is also largely influenced by litter size, as one might expect from the combined influence of a greater amount of nourishment in utero and in lactation to individuals born in small litters. No differential mortality is observed between large and small litters. In general, individuals born in small litters are larger at birth and at twenty-one days than those born in large litters, but it is not to be supposed that this initial advantage would result in greater adult weight. (See Castle ('22), who has investigated this matter in the case of rabbits.)

TABLE 5

Relation between litter size and weight, at birth and on twenty-first day

NUMBER IN LITTER	2	3	4	5	6	7	8	9	10	11	12
Average weight 1st day..	1.87	1.78	1.65	1.42	1.42	1.41	1.33	1.27	1.34	1.33	1.32
Average weight 21st day	6.85	8.55	8.76	7.35	6.95	7.20	6.92	6.47	6.54	6.30	6.79
Number young 1st day...	2	11	21	40	90	96	129	154	97	11	70
Number young 21st day..	2	6	11	30	65	61	91	80	74	10	40
Per cent diminution.....	0	45	47	25	27	36	29	48	23	9	42

SUMMARY

The statistics in this paper involve 106 litters containing over 700 individuals of mice born during the summer of 1922.

The sex ratio is practically 100 : 100.

The relative birth weights of males and females are equal.

The rate of growth of the females is slightly more rapid than that of the males, at least for the first three weeks.

The mortality is greatest as the young begin to stop nursing.

The rate of growth shows a gradual increase at first, followed by a slackening about the nineteenth day, and a final increase as the young become independent.

Litter size influences weight of the individuals both on the first day and on the twenty-first day after birth, through the available food supply, but there is no differential mortality favoring either small or large litters.

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THE FACIALIS MUSCULATURE OF THE ORANG, SIMIA SATYRUS

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SIX FIGURES

Through the courtesy of Mr. Winkleman and Doctor Dwight of the Madison Zoo we had an opportunity to dissect the facial muscles of an orang. In the course of the work it was necessary to translate the work of Ruge on the gorilla and that of Virchow on the chimpanzee. As there is but little on these animals in the English and American journals, it seems desirable to include rather full abstracts of their works. This makes them more accessible and gives a background to our description of the orang. To them we are indebted for the information on the gorilla and chimpanzee unless the contrary is indicated in the text.

Ruge's description of the muscles of the gorilla is in great detail, and would be spoiled if cut to the usual length of an abstract. With this in mind, we have taken over as much of his work as seemed necessary to maintain his meaning. One cannot work in this field without feeling under deep obligations to Ruge.

Virchow's monograph on the chimpanzee, fully illustrated, is a good example of a clear description of a complex organization and lends itself more readily to abstracting.

A recent paper by Sonntag gives additional information on the chimpanzee.

All of the papers are open to the criticism that they are based on a limited amount of material, but the supply is so limited that any description seems a step in advance. All

of the descriptions are of young animals. The probable age of the orang described is five years.

The grouping of the muscles used here is largely regional, but occasional functional and genetic relationships are suggested. Ruge and more recently Huber have given very full discussions of the latter question.

As far as possible we have used Ruge's terminology. The use of new terms even where they are slightly preferable would only make comparisons more difficult.

The method of ending of the several muscles passing to the lips was frequently difficult to determine. We have given the relations at the angles of the mouth in a separate section. If in any case the description under a given muscle seems vague, reference should be made to this section where the manner of ending is described in as far as we could determine it.

Some points of particular interest may be mentioned here. The zygomatic muscle is absent from the orang. The inner marginal bundles of the orbicular muscle of the eye go over into a distinct tendon at the lateral angle of the rima oculi and through this tendon are attached to the lateral orbital wall. The fascia over the cranial vault can be separated into two layers. There are two distinct layers of muscle in the occipital region. The orbicular fibers of the orbicular muscle of the mouth are quite different from the condition usually pictured as are also the general relations at the angle of the mouth. Each of these points is described in more detail under the muscles indicated.

The sequence of description is indicated in the outline which follows. In each case the orang is described first. This is followed by notes on the chimpanzee and that in turn by notes on the gorilla.

I. *Platysma*.

1. *Platysma* including *musculus quadratus labii inferioris*.

II. Epicranial musculature.

1. *Musculus auriculo-occipitalis* (*m. occipitalis*).
2. *Musculus orbito-auricularis* (*m. frontalis*, *m. temporoparietalis*).
3. Fascia of the cranial vault (*galea aponeurotica*).

III. Extrinsic muscles of the ear.

IV. Muscles of the orbital and palpebral regions.

1. Musculus orbicularis oculi.
2. Musculus corrugator supercilii.
3. Musculus depressor supercilii.
4. Musculus procerus.

V. Muscles of the nasal region.

1. Musculus levator labii alaeque nasi including the musculus procerus of the orang.
2. Musculus nasalis.

VI. Muscles of the oral, labial, and buccal regions.

1. Musculus zygomaticus.
2. Musculi orbito-labialis et orbito-malaris.
3. Musculus maxillo-labialis.
4. Musculus triangularis.
5. Musculus caninus.
6. Musculus buccinatorius.
7. Musculus mentalis.
8. Musculus orbicularis oris.

I. PLATYSMA

1. *Platysma of Simia (platysma myoides, musculus subcutaneus colli)*

The platysma of the orang is a heavier, thicker muscle than in man and is of greater extent. It is approximately quadrilateral in shape and covers the lower part of the face, the front and sides of the neck, and extends onto the shoulder and pectoral regions.

The origin of the muscle is along a line extending from the pectoral region a little lateral to the sternum and about opposite the third or fourth rib, in an 'irregular semicircle' through the pectoral, shoulder, and nuchal regions to a point near the superior nuchal line well behind the ear. From here fibers pass to the midline of the neck in front, the mandible, the lower lip, the upper lip, and the cheek. The line of origin begins ventrally in the pectoral region, in this case 38 mm from the midline. It curves obliquely upward from medial to lateral extending onto the arm. The direction of the line of origin from this point through the deltoideo-acromial and nuchal regions is essentially vertical, though the line is quite strongly convex dorsally. The superior end of the line of

origin is in the nuchal region about 40 mm. behind and a little above the lower margin of the ear. The most dorsal bundles of origin in the nuchal region fall short of the midline by 40 to 50 mm. In general, the origin is fascial, but some of the fibers have a bony origin from the acromion.

The fiber bundles from the pectoral and deltoid regions converge as they pass upward toward the chin. The deeper bundles attach to the lower margin of the mandible, while the more superficial ones pass over the mandible into the musculus orbicularis oris and into the skin of the lower lip and chin. The more medial of these superficial bundles decussate in the midline before crossing the margin of the mandible. So we may say that near the mandible the fibers from the two sides reach the midline, a few crossing to the opposite side. Passing caudad, they gradually diverge until they are separated by a space of 50 to 75 mm., the sternal area being uncovered.

The bundles arising in the acromial region pass forward horizontally and then curve upward at their anterior ends in a course both deep and lateral to, but parallel with, the bundles of the triangular to end at the angle of the mouth and in the upper lip. The margins of the platysma and the musculus orbito-labialis form a sharply defined angle opposite the angle of the mouth. At the apex of this angle the bundles of the two muscles interweave. The deep bundles of the platysma in this region interweave with those of the canine muscle.

The bundles arising in the nuchal region pass toward the angle of the mouth, but before reaching it end in the fascia of the face along a line passing from the external acoustic meatus to the middle of the chin. The highest fibers lie at a level somewhat higher than the inferior margin of the pinna of the ear. A few fibers arise just below and in front of the ear. The anterior ends of the lower bundles terminating in the buccal fascia are overlain by bundles from the acromial origin which curve into the upper lip.

The fiber bundles of the pectoral, cervical, nuchal, and mental regions are coarse; those of the masseteric and buccal regions are finer.

Musculus quadratus labii inferioris of Simia. Many of the deep fibers of the platysma are interrupted as they cross the mandible on their way to the lower lip. The fibers above the line of interruption reenforced by additional fibers arising from the mandible form the quadrate muscle of the lower lip.

There is a general agreement that the platysma of the orang retains more of its nuchal portion than does that of either the chimpanzee or gorilla. The interspace between the two muscles in front is least in the chimpanzee. Data on the relative amount of decussation are unsatisfactory.

Platysma of Anthropopithecus. For the platysma of the chimpanzee the description given by Sonntag is somewhat clearer than the one by Virchow, and is used here. The muscle arises from the fascia over the greater pectoral and deltoid muscles. The muscles of the two sides are inseparable in the midline of the neck. The lateral parts are more muscular and thicker than the medial portions. About 25 mm. below the symphysis menti the bundles of the mesial parts decussate, the bundles of the left muscle lying superficial to those of the right. The fibers are attached to the lower border of the mandible, the skin of the lips, the muscles of the lips, and angles of the mouth. On the face it separates into upper and lower bundles of fibers. The former, corresponding to the musculus risorius in man, run to the muscles at the angle of the mouth, and the latter which are much larger blend with the skin and muscles of the lower lip. Sonntag also describes a portion which passes over the nuchal region to attach to the ear, occipital crest, occipital muscle, and the deep fascia of the back of the neck. The platysma and triangular muscle pierce each other at intervals (Virchow). At the angle of the mouth the platysma is covered by a thin layer of the zygomatic (Virchow).

Musculus quadratus labii inferioris of Anthropopithecus. The condition for the quadrate muscle of the lower lip of the chimpanzee is essentially like that described for the orang.

Platysma of Gorilla. The platysma of the gorilla is a flat subcutaneous muscle consisting of approximately parallel bundles. The fibers run from the lower lip, the angles of the mouth, the upper lip and cheek, down over the neck and breast. The upper margin is about 10 mm. below the auricle. The fibers crossing the angle of the mandible end in the acromial region. The bundles from the angle of the mouth, the upper lip and cheek cover the side of the neck. The posterior boundary of the muscle is on a line from the acromion to the ear. It does not extend farther onto the back of the neck. On the breast it ends at the level of the third rib. At the sternal notch the muscles of the two sides are well separated, but toward the chin they cross. On the face it is convenient to discuss the platysma in two parts, an inferior labial portion below the corner of the mouth and a bucco-labial portion above the corner. The inferior labial bundles ascend over the medial part of the mandible and are arranged as a superficial and a deep layer. The superficial layer runs without interruption from the neck to the lower lip. The deep fibers are interrupted at the mandible and are thus divided into a cervical and an inferior labial portion. The cervical portion is weak; the labial portion well developed. Both the superficial and deep portions have a common insertion into the skin of the lower lip.

Musculus quadratus labii inferioris of Gorilla. The deep bundles of the inferior labial portion, because of their independence of the cervical part and because of their attachment to the mandible and their greater volume, may be considered as forming a separate muscle, the musculus quadratus or depressor labii inferioris. The greater volume is due to the presence of new fibers arising from the mandible.

II. EPICRANIAL MUSCULATURE

Under the head of epicranial musculature we are including the muscles covering the occipital, parietal, temporal, and frontal regions. It includes the auriculo-occipital and orbito-auricular muscles. They occupy much the same position as

the musculus epicranius in man, but differ in extent and attachments. Here we shall also discuss the fascia of the cranial vault.

1. *Musculus auriculo-occipitalis of Simia*

The auriculo-occipital muscle of the orang may be divided into an occipital and a nuchal portion. The entire muscle is superficial in the occipital and upper nuchal regions, but is covered by a distinct layer of fascia which is interposed between the muscle and the skin.

Pars occipitalis. This portion has an origin from the external occipital protuberance and along the superior nuchal line nearly to the ear. From the line of origin the more medial fiber bundles pass vertically upward onto the scalp; the more lateral curve upward and forward to end in an aponeurosis.

The fleshy fibers end along a line extending from the vertex to the root of the ear. The most lateral fibers insert into the upper and dorsal part of the root of the ear where they lie superficial to the insertion of the superior auricular muscle. The occipital portion is ensheathed in a fascia which is continuous with the fascial investment of the superior auricular and orbito-auricular muscles.

The muscles of the two sides are not identical in extent. Near the origin the muscle of the left side reaches the mid-line, that of the right falls short by about 10 mm. The muscle of the left side does not quite reach the vertex, that of the right side extends a little beyond. The muscles of the two sides converge near the vertex.

Musculus occipitalis profundus. We have used this name for a small muscle of doubtful homology which lies deep to the auriculo-occipital muscle. It has an origin for about 10 mm. along the middle of the superior nuchal line. From here the fibers pass upward, fleshy for about 20 mm., at right angles to the fibers of the auriculo-occipital muscle. It continues the direction of the sterno-cleido-mastoid muscle. It ends in the deeper layer of fascia of the cranial vault.

Pars nuchalis. The nuchal portion is represented by two bundles, each 2 or 3 mm. wide, which overlie the musculus trapezius at its attachment to the skull. These bundles have an aponeurotic origin from the external occipital protuberance. From here they pass laterad and again become tendinous as they cross the nuchal line a little behind its middle. They end in the pars occipitalis of the auriculo-occipital muscle.

Musculus auriculo-occipitalis of Anthropopithecus. This muscle of the chimpanzee is described by Virchow as the occipital and by Sonntag as the occipito-frontal. According to Sonntag, it is subject to much variation. Although in general its muscle bellies have been described as small, Ruge has described a relatively large fleshy portion with an auricular segment. Sonntag describes it as arising from the middle two fourths of the occipital crest and passing forward for nearly 50 mm. to end in a well-marked aponeurosis.

Musculus auriculo-occipitalis of Gorilla. The muscle of the gorilla may be divided into occipital and nuchal portions.

Pars occipitalis. The occipital or cranial portion arises from the heavy periosteum of the superior nuchal line. The greater part of the bundles run over the occipital region and end at the level of the parieto-occipital suture. The more lateral bundles run horizontally and end on the medial surface of the concha just above the insertion of the posterior auricular muscle.

Pars nuchalis. The nuchal portion is a delicate sheet extending from the superior nuchal line obliquely downward and mediad to the ligamentum nuchae. It is covered in part by the musculus transversus nuchae, a remnant of the platysma.

2. *Musculus orbito-auricularis of Simia*

In the orang this is a broad, flat sheet covering the frontal and temporal regions. It is largely superficial, but is covered in part by portions of the muscoli orbito-labialis, orbicularis oculi, depressor supercilii, and levator labii alaeque nasi.

The muscle has an origin along the entire superior margin of the orbit and along the upper half of the lateral margin. From their origin the lateral bundles extend downward and somewhat backward to end in the masseteric fascia. (The dorsal ends of these lateral bundles are covered by the orbito-labial muscle and their real extent is not clearly suggested in the illustration.) These bundles pass over the zygomatic arch without attaching to it. The medial bundles pass upward and backward to the fascia over the cranial vault and through this fascia are connected with the auriculo-occipital muscle. The fascia is described in detail a little farther on. The intermediate bundles take a direction intermediate to the other two and end by blending with the temporal fascia along its line of attachment near the ear.

The muscles of the two sides meet in the midline. The fibers nearest the midline are the shortest.

Musculus orbito-auricularis of Anthropopithecus. For the regions occupied by this muscle in the orang Virchow has described two muscles, the temporo-parietal and the frontal, in the chimpanzee. Sonntag describes only a small frontal muscle. Virchow's description is used here.

Musculus epicranii temporo-parietalis (Virchow). This muscle borders on the frontal and orbicular muscles anteriorly and extends backward to the region above the ear. It is divided into two segments, an anterior and a posterior, connected by an isthmus. In the anterior segment the fibers in front have the same general direction as those of the frontal muscle, and it is impossible to distinguish them from those of the latter. Farther posteriorly the fibers hit the edge of the frontal muscle at a right angle. The fibers of the isthmus and of the posterior segment are attached above to the fascia over the cranial vault. The fibers of the isthmus after a short course again go over into fascia. The fibers of the posterior segment end on the ear and in the fascia behind the ear. The attachment to the concha is such that the muscle in approaching the helix does not fasten itself to it immediately, but first diverges both upward and downward.

This posterior segment is called the superior auricular muscle by most authors. Virchow thinks that name inadequate.

Musculus frontalis (Virchow). The two frontal muscles form a plate 27 mm. high. The upper edge of this plate, right to left, is without a median indentation. Where the muscle borders on the temporo-parietal a portion 8 mm. wide extends farther backward. In the lateral half of the superior orbital margin it runs at a right angle to the orbicular muscle of the eye. In the median half and on the glabella it is united with the musculus procerus in a heavy connective tissue not capable of being analyzed further so that it appears to go over in part into that muscle.

One finds in the medial half of the superior orbital margin a heavy connective tissue, an analysis of which is so difficult that it is not possible to isolate the separate elements of the following muscles, musculus procerus, depressor capitis supercilii, corrugator supercilii, frontalis, and upper marginal bundles of the orbicularis oculi.

Virchow and Sonntag seem in agreement that the frontal muscle has no attachment to the bone. Sonntag says that it arises from the supra-orbital ridges and the space between, but goes on to say that it is easily removed with the skin.

Musculus orbito-auricularis of Gorilla. Ruge considers the frontal and superior and anterior auricular muscles as derivatives of the orbito-auricular muscle of the gorilla. The frontal muscle will be described here, the auricular muscles with the extrinsic muscles of the ear.

Musculus frontalis. The frontal muscle of the gorilla covers the entire frontal region as a single sheet, only delicate lateral bundles are somewhat separated off. There is an occasional tendinous interruption of the fibers. The medial part adjoins that of the opposite side. The lateral bundles extend farther onto the skull than the medial and partly overlie the anterior auricular muscle. Where the frontal muscle does not overlie the latter, it is closely attached to the 'galea aponeurotica.'

Near its origin the frontal muscle is covered by the *musculus orbicularis oculi* and medially by the *musculi depressor supercilii*, *procerus nasi*, and superficial part of the *corrugator*. The medial and lateral bundles arise from a strong fascia below the orbital margin. The most lateral bundles ascend 12 mm. beyond the orbital margin. Strong bundles forming the middle portion divide above the orbital margin into slips which run laterad and downward and form a superficial layer over the lateral bundles. Medially strong slips can be traced downward into the orbit. They arise from the lacrimal and frontal bones. The upper bundles from this origin take a transverse course.

3. *Fascia of the cranial vault of Simia*

On superficial examination it would appear that the fascial or aponeurotic relations in the orang are very like those of man. Further study shows, however, that the fascia is readily separable into two layers, a superficial and a deep.

The superficial layer occupies the space between the fleshy portions of the auriculo-occipital, orbito-auricular, and superior auricular muscles. It may properly be considered the aponeurosis of these muscles and might be called the galea aponeurotica if it were not for its weak organization and for the presence and relations of the deep layer. In general the superficial layer is thicker than the deep.

The deep layer underlies the superficial throughout. It is attached behind to the superior nuchal line. In front, on either side, it is continuous with the temporal fascia which has but a weak attachment to the intermediate part of the temporal line. More medially it is attached along the margin of the orbit. The medial portion in front receives some deep bundles of the orbito-auricular muscle, and behind some deep bundles of auriculo-occipital. Posteriorly there is also the '*musculus occipitalis profundus*' ending entirely in this deep layer.

There is good evidence both in the fascia and in the muscles that we are dealing with a condition derived from two

primary layers or with the progressive differentiation of a single layer into two layers. While the evidence is not complete for either case, it favors a primary condition of two layers.

Fascia of the cranial vault of Anthropopithecus. Neither Virchow nor Sonntag gives any detailed description of this region of the chimpanzee. It would appear both from their figures and text that the aponeurosis is large and the fleshy portions small. This seems to represent accurately the situation, for several authors describe no fleshy parts. Ruge, however, describes an extensive muscle element and a small aponeurosis.

Fascia of the cranial vault of Gorilla. In the gorilla all of the occipital bundles lie so directly upon the movable, firm, subcutaneous tissue of the head that the latter follows everywhere the movements of the muscle. Nowhere in the fascia can embedded tendinous fibers be recognized, and it therefore does not deserve the name 'galea aponeurotica.' It is less easily removed from the skull medially than laterally. It attaches to the posterior and superior margins of the superior auricular muscle, to which it is related in much the same way as to the auriculo-occipital.

The fascia first receives aponeurotic parts in man, in that tendinous portions of the muscles going over into it, especially the occipital, continue directly into it. So, parts of the fascia do not become aponeurotic, but parts of the muscle do.

This is a very inadequate summary of Ruge's discussion of fascia, and one interested in the problem will be well repaid by referring directly to his paper on the gorilla.

III. EXTRINSIC MUSCLES OF THE EAR

Extrinsic muscles of the ear of Simia

Only the superior auricular muscle of the orang is present as an independent muscle. The anterior auricular muscle is not separated from the orbito-auricular; the posterior is included in the auriculo-occipital.

Musculus auricularis superior. In the orang this is a relatively small muscle lying immediately above the ear. It practically fills an interspace between the fleshy portions of the auriculo-occipital and orbito-auricular muscles and has a fascial connection with each of them. It arises from the fascia in the upper part of the temporal region and inserts into the eminentia conchae.

Extrinsic muscles of the ear of Anthropopithecus

In the chimpanzee Virchow describes anterior and posterior auricular muscles, but includes the superior auricular as the posterior segment of the musculus epicranii temporo-parietalis. Sonntag describes briefly an anterior auricular, a combined superior and posterior auricular muscle, and a small musculus tragicus.

Musculus auricularis anterior. This muscle of the chimpanzee is the same as that of man. Its attachment to the concha is deeper than that of the superior auricular muscle. The attachment to the ear is 4 mm. wide; the anterior end of the muscle on the 'galea' is 9 mm. wide; its inferior edge is 8 mm. long.

Musculus auricularis posterior. This muscle of the chimpanzee consists of two portions, an upper and a lower. The upper part, about 5 mm. wide, arises through a tendon near the lateral edge of the occipital muscle and passes in a gentle curve to the ear. The lower part, slightly the wider, is separated from the upper at their origins, but comes to lie along its lower edge. Both approach the ear still fleshy, and after bridging over the furrow between the eminentia conchae and the eminentia scaphae attach to the latter. From here a small bundle arches downward to end in the connective tissue of the eminentia conchae. The insertion covers that of the transverse auricular muscle.

Extrinsic muscles of the ear of Gorilla

For the gorilla Ruge describes a *musculus auricularis posterior* and a *musculus auricularis anterior et superior*. The latter he considers a derivative of the orbito-auricular. In addition there is described a *musculus depressor helcis*.

Musculus auricularis anterior et superior. The muscle as a whole has an origin from the 'galea aponeurotica' of the parietal region, the fascia of the temporal region and from a fascia attached to the orbital margin and zygoma.

The general insertion is on the helix. The fibers, especially the anterior, are frequently interrupted by fascia as they pass to their insertion. The bundles representing the anterior auricular muscle are broken and of very delicate fibers. It is covered in part by the frontal muscle. The part corresponding to the superior auricular muscle is distinctly separated from the occipital.

Musculus auricularis posterior. In the gorilla this muscle arises from the superior nuchal line lateral to the auriculo-occipital. A few bundles have a delicate tendinous origin below this. The muscle is about 3 mm. wide and goes to the posterior surface of the concha. The upper bundles at their origin are covered for a short distance by the lateral bundles of the auriculo-occipital muscle.

The auricular, frontal and occipital muscles are all attached to the 'galea aponeurotica' but have no tendon into it.

IV. MUSCLES OF THE ORBITAL AND PALPEBRAL REGIONS

In this group are included the *musculi orbicularis oculi*, *corrugator supercilii*, *depressor supercilii*, and *procerus*.

1. Musculus orbicularis oculi of Simia

The orbicular muscle of the eye of the orang is subcutaneous except in its medial part where it blends with the *musculi levator labii alaeque nasi*, orbito-auricularis, and *depressor supercilii*. It is usually described as consisting of orbital, palpebral, and lacrimal portions. The palpebral

portion forms much the greater part of the muscle. The orbital part is relatively narrow. The fiber bundles lying toward the margin of the upper lid are finer than the more peripheral bundles. The fact that the orbital contents were distended by the injection of formalin may have had an influence in producing this condition (fig. 1 shows the degree of distention), but the eyes in this case and in one other young orang observed were normally rather protuberant.

Pars palpebralis. The palpebral portion forms a well-developed sheet throughout the lids. The bundles arise from the medial palpebral ligament. Laterad most of the bundles pass around the angle without interruption. There is no raphé comparable to the fascial line formed in man.

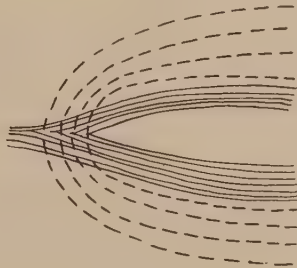


Figure 1

A most interesting condition is found in the inner marginal bundles, those adjacent to the rima. These bundles from the two lids interweave at the lateral angle and form a strong narrow band that passes laterad deep to the more peripheral bundles. This band soon becomes tendinous and after being joined by the lateral tarsal ligament attaches to the zygomatic bone just within the margin of the orbit. A few of the more peripheral bundles of the upper lid end in this ligament.

The attachment of the orbicular muscle to the zygomatic bone through a tendon has not been described for the chimpanzee or gorilla. In the orang the condition is very clear and the tendon is much stronger than the lateral tarsal liga-

ment which joins it. In man a few bundles may end on the lateral tarsal ligament, but the condition is not directly comparable to that in the orang.

Pars orbitalis. The bundles of the orbital portion arise from the well-defined medial palpebral ligament and from the bone adjacent to it. They pass around the lateral angle without much interruption. A few of the bundles, both upper and lower, end in the fascia above the middle of the eye.

Pars lacrimalis. A considerable number of bundles have a fibrous origin from the posterior lacrimal crest. They pass laterad behind the upper part of the lacrimal sac into the two lids and appear to be continued into the inner marginal bundles. While the dissection was not entirely satisfactory, we could not determine an insertion as originally described by Horner for man.

Musculus orbicularis oculi of Anthropopithecus. In his discussion of the orbicular muscle of the eye of the chimpanzee Virchow points out that the division into orbital and palpebral portions is convenient for description, but has no systematic significance.

The origin is on the medial palpebral ligament and on the bones above and below. The orbicular muscle in the lower lid comes from the ligament, from the inferior orbital margin, and from the nose. The origin on the nose reaching to the midline is covered by the musculus procerus and unites with the musculus levator alae nasi.

The bundles for the upper lid arise high up on the nose for 15 mm. above the medial palpebral ligament. The fibers arising high up do not in their further course run especially high, but run below the orbital margin in a direction almost horizontal.

From the lateral edge of the muscle a bundle 1.5 mm. wide runs parallel to the zygomatic muscle to the upper lip.

Sonntag pictures a somewhat different condition opposite the medial angle. He shows the line of origin as horizontal rather than vertical as described by Virchow. He also mentions a lateral palpebral raphé.

Musculus orbicularis oculi of Gorilla. In this muscle of the gorilla Ruge has included only those bundles which have retained in some degree their circular course. As derivatives of it he includes the muscoli levator labii alaeque nasi, procerus nasi, depressor supercilii, and corrugator supercilii.

The inferior margin of the orbicular muscle of the eye is formed by a bundle arising from the temporal fascia over the zygomatic bone and running upward and forward closely associated with the orbito-malar.

The superior marginal bundles laterad take a sudden steep course and lie almost parallel to the orbital margin. The scattered lateral marginal bundles are firmly fixed in the superficial temporal fascia.

In the immediate region of the orbit the orbicular bundles are very strong and extend beyond the limits of the lids. They all run toward the medial angle of the eye; those from below passing to the medial palpebral ligament; those from above to the frontal process of the maxilla and over into those of the lower lid.

The upper supra-orbital bundles run medially and end in common with the depressor of the supercilium in the subcutaneous tissue over the supra-orbital ridge. Lateral to the outer angle of the eye the fibers decussate to some extent. There is no well-marked lateral raphé.

Ruge attaches some significance to the lateral extent of the orbicular muscle of the eye. It is greatest in man: then in order come the chimpanzee, gorilla, and orang (Ruge).

2. *Musculus corrugator supercilii of Simia*

In the orang we felt that a corrugator was not represented. One might consider a few of the more lateral bundles of the depressor of the supercilium as a separate muscle, but we prefer to think of the entire structure as a depressor muscle.

Ruge has described for the orang a corrugator muscle arising from the lacrimal bone and running to the forehead.

Musculus corrugator supercilii of Anthropopithecus. In the chimpanzee the corrugator muscle has an origin 10 mm.

wide from the side of the root of the nose. The origin of the upper bundles lies nearer the midline than that of the lower. The space between the muscles of the two sides is about 4 mm. The muscle is directed laterad and slightly upward and extends to the middle of the brow region and also in part into the superficial muscle layer at the level of the orbital margin.

The relation of the corrugator muscle to the orbicular muscle of the eye is shown more clearly in the chimpanzee than in man, for in the former the origin of the orbicular muscle extends so far upon the nose that it unites with the origin of the corrugator.

Musculus corrugator supercilii of Gorilla. In the gorilla there is a trace of a corrugator muscle. It arises in two bundles from the frontal process of the maxilla under cover of the medial palpebral ligament. It passes upward and mediad to the subcutaneous fascia in the region of the glabella.

The corrugator represents a deep portion of the orbicular muscle which has attained its independence.

3. *Musculus depressor supercilii of Simia*

The depressor of the orang consists of a relatively thin layer of muscle having a narrow fibrous origin from the nasal process of the frontal bone. It expands as it passes upward and laterad to end above the middle of the eye in the fascia of the supra-orbital region.

The depressor muscle at its origin blends with that of the orbito-auricular. Here it is covered by the orbital portion of the orbicular muscle of the eye. Above it is at the same depth as the upper bundles of the musculus levator labii alaeque nasi which adjoin it medially. Below as the depressor passes deeply to its origin it is covered by the levator muscle as the latter passes down to its insertion.

Musculus depressor supercilii of Anthropopithecus. Under the musculus depressor capitis supercilii Virchow gives the following description for the chimpanzee. This is a

triangular muscle united with and belonging to the orbicular muscle, but because of its individual peculiarities it should be mentioned as a separate muscle. It is convenient to divide it into a superficial and a deep portion.

The superficial layer may be described as a bundle of the orbicular muscle which passes the medial palpebral ligament and widens as it extends upward.

The deep part is triangular with its apex above the medial palpebral ligament. Below its lateral margin it is united with the palpebral part of the orbicular muscle; above it is completely separated from it.

In following the muscle from superficial to deep several changes in its character are seen. The superficial part consists of rounded bundles loosely arranged; the deep of flat bundles packed together in close formation. The superficial part consists largely of bundles from the lower lid; the deep arises entirely from the bone. The superficial part lies the more laterad at its origin.

The depressor of the supercilium is separated below, but united above with the *musculus procerus*.

Musculus depressor supercilii of Gorilla. The strip of muscle spread out from the medial palpebral ligament to the supra-orbital margin as the *musculus depressor supercilii* can in the gorilla be considered only as the upper part of the *musculus levator labii alaeque nasi*. It covers the supratarsal bundles of the orbicular muscle.

Ruge considers the depressor a superficial portion of the orbicular muscle which has become independent.

4. *Musculus procerus of Simia*

This muscle of the orang is described as part of the *musculus levator labii alaeque nasi*, with which it is closely associated.

Musculus procerus of Anthropopithecus. Virchow describes this muscle of the chimpanzee as the *musculus depressor glabellae*. It is a small muscle arising from the bony part of the nose 9 mm. above the *apertura pyriformis*.

It ends above by interweaving with the depressor of the supercilium and orbicular muscles.

The principal facts in regard to it are that it takes origin from the bone, that it lies above the pyriform aperture, that it is small below and spreads out above, and that it interweaves on the nose with the muscoli orbicularis oculi and depressor supercilii.

Musculus procerus of Gorilla. In the gorilla this muscle arises well below the medial angle of the eye from the periosteum of the nasal bone. It passes upward to the subcutaneous fascia over the glabella where its bundles interdigitate with the frontal muscle and are connected to some extent with a bundle of the corrugator of the supercilium. The muscles of the two sides fuse in the midline.

V. MUSCLES OF THE NASAL REGION

In this group we have included only the muscoli levator labii alaeque nasi and nasalis.

1. *Musculus levator labii alaeque nasi of Simia*

In the orang the space between the eyes is occupied by a muscle sheet which extends from the frontal region to the upper lip and the wing of the nose.

The upper part of the muscle is continuous with the orbitoauricular and overlies its medial part. It has the position of the musculus procerus in man. It lies superficial to the lower part of the depressor of the supercilium.

The lower portion of the muscle corresponds in part to the angular head of the superior quadratus muscle of man. It ends on the dorsum and wing of the nose and in the upper lip. The fibers nearest the midline have a weak bony attachment to the nasal bone. The insertion into the upper lip extends laterally from the wing of the nose to just above the angle of the mouth. The bundles overlie those of the maxillo-labial muscle medially and are closely bound to them. More laterally the bundles interweave with those of the orbito-labial. The medial bundles without doubt represent a poorly differentiated musculus procerus.

Musculus levator labii alaeque nasi of Anthropopithecus. Virchow has described this muscle as the *musculus levator alae nasi*. What he has described as the *musculus levator labii superioris* we have included as the maxillo-labial muscle.

This muscle of the chimpanzee is 8 mm. wide throughout its extent. It is composed of coarse bundles. It arises along a horizontal line, the medial end of which reaches almost to the midline of the dorsum of the nose. This line corresponds to the lower end of the *musculus procerus*. It arises in scattered bundles, of which a lateral bundle is attached at a considerable distance from the rest. Two small bundles separate off and go over into the orbicular muscle of the eye.

The muscle courses downward and then strongly laterad. Its lower end lies in front of the maxillo-labial muscle and attaches to the skin of the wing of the nose and to the skin lateral to this.

Musculus levator labii alaeque nasi of Gorilla. The levator of the gorilla is derived from the portion of the orbicular muscle below the rima oculi, only a few bundles finding attachment to the medial palpebral ligament.

The strong medial bundles run as a narrow sheet directly upward to the supra-orbital margin, where they diverge and end in the subcutaneous tissue over the frontal muscle.

The lateral bundles run to the upper lip and end upon the maxillo-labial muscle. The nasal bundles fasten to the strong calloused skin of the nose.

2. *Musculus nasalis of Simia*

In the orang there is a narrow strip attached to the maxilla in the plane of the lateral incisor. It passes upward close to the bone just lateral to the external nares to end on the dorsum of the nose in continuity with the bundles of the *musculus levator labii alaeque nasi*.

The nasal muscle lies deep to the levator of the lip and to the maxillo-labial muscle. It is medial to the canine muscle.

Musculus nasalis of Anthropopithecus. In the chimpanzee the nasal muscle arises along an oblique line in the region of

the alveoli of the incisor and canine teeth. It forms a broad thin muscle plate which inserts into the skin around the margin of the nostril and lateral to the margin. It does not encircle the nostril to go over onto the middle zone of the nose.

Musculus nasalis of Gorilla. The nasal muscle of the gorilla arises from the juga alveolaria of the two incisor teeth. The bundles ascend vertically. The medial bundles which reach the midline are delicate and run to the subcutaneous fascia in the groove between the nares. The lateral bundles are more strongly developed and attach to the lower and lateral surfaces of the wing of the nose.

Ruge considers the nasal muscle a derivative of the orbicular muscle of the mouth.

VI. MUSCLES OF THE ORAL, LABIAL, AND BUCCAL REGIONS

In this group we have included a large number of muscles which agree in having an insertion at or near the lips and act on the lips or cheeks. The muscles in the list following may be thus grouped together: *Musculus zygomaticus*; *musculus orbito-labialis et orbito-malaris*; *musculus maxillo-labialis*; *musculus triangularis*; *musculus caninus*; *musculus buccinatorius*; *musculus mentalis*; *musculus orbicularis oris*.

1. *Musculus zygomaticus of Simia*

This muscle is absent from the orang. The only suggestion of a zygomatic muscle is found in a few deep bundles of the orbito-labial. These arise from the zygomatic arch and the fascia over it and enter the deep surface of the orbito-labial muscle.

Musculus zygomaticus of Anthropopithecus. The zygomatic muscle of the chimpanzee has a width of 10 mm. throughout its entire length. At its upper medial end it is joined by a muscle of a similar course ("intermediate bundles between the *zygomaticus* and *orbicularis oculi*"), so that at first glance it appears double its true width.

The zygomatic has a tendinous origin along an oblique line entirely on the temporal bone. The line of origin runs

parallel to the zygomatico-temporal suture, but at a distance of 3 mm. from it.

At the lip the zygomatic muscle divides into three layers. The superficial layer covers the muscoli orbicularis oris, caninus and platysma. After the removal of this layer a superficial layer of the canine appears. Beneath this is a middle layer of the zygomatic. Then comes another layer of the canine, and finally a third layer of the zygomatic. The latter is pierced by a layer of the canine muscle. This layer formation can only be described for the region of the mouth, as far as the orbicular and canine muscles the zygomatic is undivided. The superficial layer is thin and spreads out especially in the upper lip, but a bundle 6 mm. wide goes into the lower lip covering the platysma.

The deepest portion of the zygomatic sends a slip 5 mm. wide to the lower lip and one 7 mm. wide to the upper lip. In the lower lip there is a crossing with the deep layer of the platysma. The superior labial part does not extend to the free margin of the lip. Isolated bundles can be followed far mediad especially to the region of the fornix of the mucosa. As a separation from the orbicular muscle is not further possible, it cannot be said how far the zygomatic bundles extend. From this deep layer a very deep bundle about 2 mm. wide separates off and sinks into the buccinator 9 mm. behind the angle of the mouth.

Musculus zygomaticus of Gorilla. The zygomatic muscle of the gorilla arises by a strong tendon from the zygomatic bone. It is about 2 mm. wide at its origin, but spreads out toward its insertion until it is 9 mm. wide. It inserts into the subcutaneous fascia of the upper lip. The antero-medial end of the line of insertion is above the angle of the mouth so the insertion falls lateral to this. It lies superficial to the orbicular muscle of the mouth, for it has no deep bundles of insertion. Its lateral bundles are partly covered by the platysma.

The zygomatic muscle of the chimpanzee differs from that of the gorilla in that it has well-developed deep bundles of insertion.

2. Musculi orbito-labialis et orbito-malaris

These are described by Ruge for the gorilla as derivatives of the musculus orbicularis oculi. Virchow describes similar muscles in the chimpanzee under the name of "intermediate bundles between the zygomaticus and orbicularis oculi," while Sonntag includes them in the 'zygomatic mass.' In the orang they fall most readily into the group of muscles about the mouth.

In his earlier work on the Primates Ruge pictures the orbito-labial muscle of the orang as the zygomatic, but in a later study states that the zygomatic is absent. This agrees with our observations. Neither the origin nor the insertion suggests that this is the zygomatic. The muscle may be considered the equivalent of the zygomatic head of the musculus quadratus labii superioris of man.

Musculus orbito-labialis of Simia (musculus temporo-labialis, musculus zygomaticus minor). In the orang this is one of the superficial muscles of the face above the plane of the angle of the mouth. It runs from the temporal region to the upper lip. The dorsal end of the inferior margin of the muscle has a fascial continuity with the upper part of the platysma, while the ventral part is relatively free and sharply defined and opposite the angle of the mouth forms a well-defined angle with the platysma.

The muscle has an aponeurotic origin in the temporal region: a few fleshy fibers can be traced as high as the level of the external acoustic meatus. The insertion is into the upper lip just medial to the angle of the mouth. Toward its insertion it interweaves with bundles of the platysma which pass to the upper lip and with bundles of the triangular muscle. In addition to the bundles already described, there are several bundles entering its deep surface. These have an origin from the zygomatic arch and the fascia over it, for the most part deep to the orbito-auricular.

The muscle is made up of relatively coarse bundles. In contrast to the muscle of the gorilla as described by Ruge, it has a relatively uniform width, the width increasing a little at the origin.

Musculus orbito-malaris of Simia. This muscle consists of a few fibers lying between the muscoli orbito-labialis and orbicularis oculi. In the orang it attains no great size and might well be considered as a part of either of these muscles.

Musculi orbito-labialis et orbito-malaris of Anthropopithecus. Virchow refers to these muscles of the chimpanzee as "intermediate bundles between the muscoli zygomaticus and orbicularis oculi."

Between the zygomatic and orbicular muscles is an interspace of 11 mm. In this are a number of bundles which have exactly the same direction as the zygomatic muscle. They do not, however, arise from the bone as a single compact bundle, but each bundle is attached separately to the temporal fascia. One of these bundles, 1.5 mm. wide, comes off from the margin of the musculus orbicularis oculi and is described with that muscle. After this muscle reaches the orbicular muscle of the mouth it behaves exactly as does the zygomatic; that is, it spreads out on the surface of the orbicular muscle.

Sonntag says of the 'zygomatic mass': "In my specimen it is the most powerful muscle of the face, and has three powerful heads of origin. A strong bundle separates from the orbital part of the musculus orbicularis palpebrarum, the zygomaticus minor springs from the malar bone and temporal fascia, and the zygomaticus major arises from the anterior end of the zygoma. The three bundles unite to form a strong muscle an inch wide blending with the muscles of the lips and angle of the mouth."

Musculi orbito-labialis et orbito-malaris of Gorilla. These two muscles form an intermediate sheet between the muscoli zygomaticus and orbicularis oculi. At their origin they are closely associated with the orbicular muscle.

The orbito-labial is the larger lateral part of this sheet and runs from the region of the orbit to the region of the upper lip. At its origin it is separated from the zygomatic by about 4 mm. Near its insertion it is united with it.

The orbito-malar, the smaller of the two, runs from the orbital to the malar region.

3. *Musculus maxillo-labialis of Simia*

The greater part of this muscle in the orang has its origin along the inferior margin of the orbit except the lateral part. Mediad it extends as high as the medial palpebral ligament. There is also a head of origin 2 or 3 mm. wide from the zygomatic bone close to the zygomatico-maxillary suture and a little below the plane of the infra-orbital foramen.

The muscle passes downward for an insertion into the upper lip medial to the angle of the mouth, extending mediad as far as the lateral margin of the nose. It sends a few bundles to the wing of the nose. There is a deeper slip of this muscle which ends in the mucosa of the upper lip in the plane of the canine tooth.

The maxillo-labial is overlapped medially by the *musculus levator labii alaeque nasi* with which it is very closely associated except at its origin. Its infra-orbital attachment is covered superficially by the orbicular muscle of the eye.

Musculus maxillo-labialis of Anthropopithecus. Virchow describes this muscle of the chimpanzee as the *musculus levator labii superioris*.

This muscle arises along an irregular line, some bundles higher than others. The field of origin is directly on the suture between the zygomatic and maxillary bones and is placed obliquely with its medial end higher than the lateral. It is 14 mm. wide at the origin and widens only a little toward its insertion. A small medial portion runs in an almost horizontal direction to the skin near the external nares (wing of the nose); the greater part runs into the upper lip and spreads out here in a thin layer on the outer surface of the orbicular muscle bordering the 'intermediate bundles.' It spreads medially so that it runs over the entire upper lip to the midline. The lateral edge of this muscle is covered by the 'intermediate bundles' and especially by the superior labial bundles of the orbicular muscle of the eye.

Musculus maxillo-labialis of Gorilla (*musculus maxillo-labio-nasalis*, *musculus levator labii superioris proprius*). The maxillo-labial muscle of the gorilla takes origin from

the maxilla just below the zygomatico-maxillary suture, but above the infra-orbital foramen.

The bundles diverging run downward vertically to the upper lip and obliquely forward to the nose. About a third of the bundles run to the upper and lateral edge of the protuberant wing of the nose. Some of the bundles run downward around the wing of the nose to the fossa beneath the nasal opening. These bundles interweave with the *musculus levator labii alaeque nasi*. The nasal muscle lies lateral to and below them. The superior labial bundles attach themselves to the subcutaneous tissue at a distance of 3 to 5 mm. from the edge of the lip. They are divided into two segments, medial and lateral, by bundles of the orbicular muscle of the mouth.

In the chimpanzee the muscle is more primitive and one bundle of origin is still below the infra-orbital foramen (Ruge).

In man the equivalents of the *musculi maxillo-labialis*, *levator labii superioris alaeque nasi*, and *orbito-labialis* (*zygomaticus minor*) form the *musculus quadratus labii superioris*.

The maxillo-labial muscle of the orang corresponds to the maxillo-naso-labial of the dog and to the levator of the upper lip of the gorilla (Huber). The latter is called the maxillo-labial by Ruge. The corresponding muscle in the chimpanzee is the levator of the upper lip. The equivalent in man is the infra-orbital head of the *musculus quadratus labii superioris*. In the orang the maxillo-labial may also represent part of the angular head of the quadrate muscle of man.

4. *Musculus triangularis of Simia*

The triangular muscle of the orang is subcutaneous and lies in a plane behind the angle of the mouth. Its dorsal margin is sharply defined below, but above is blended with the bundles of the platysma which pass above the angle of the mouth.

There is a narrow bony origin from the lateral surface of the mandible near its lower margin, below and behind the

mental foramen and in the plane of the first milk molar tooth. There is also a fascial origin about twice as wide as the bony from the fascia over the platysma in a line above and behind the bony attachment. The bundles arising from the bone are aponeurotic near their origin and attach in common with bundles of the musculus quadratus labii inferioris which is described with the platysma.

The insertion is at or near the angle of the mouth. A few superficial bundles end in the fascia behind the angle of the mouth; some interdigitate with bundles of the orbito-labial. Further details of the insertion are described with the musculus orbicularis oris.

The triangular muscle is for the most part superficial to the platysma and a few of its more anterior bundles overlies the posterior bundles of the musculus quadratus labii inferioris. An occasional bundle of the platysma may pass superficial to or through the triangular. We noted one bundle passing superficial to and two bundles passing through.

Musculus triangularis of Anthropopithecus. The triangular muscle of the chimpanzee consists of a part derived from the orbicular and a part derived from the canine muscle. It emerges at the lower edge of the superficial platysma bundles. It consists of two parts which lie close together, a shorter posterior portion and a longer anterior. The posterior portion is entirely free, the anterior is only free below and elsewhere is somewhat covered by wide platysma portions which break through the triangular. The two muscles interweave.

The musculus triangularis is very weak and thin; so thin, in fact, that under unfavorable light conditions it is seen with difficulty. It has no bony attachment at its lower end.

Musculus triangularis of Gorilla. Ruge describes the musculus triangularis of the gorilla together with the musculus caninus and the pars orbicularis as part of the 'system of the orbicularis oris.'

The triangular is found only in primates and is lacking even in the lower forms of this group. In its early stage of development it is represented only by a few bundles of the

musculus orbicularis oris which run from the upper lip below the corner of the mouth to fasten to the skin of the lower lip upon the platysma. The muscle first properly bears the name 'triangularis' in the higher primates where it pierces the platysma in various ways near the angle of the mouth and then through divergence of its bundles attaches with a broad base to the margin of the mandible. There is a continuity of the triangular and canine muscles which is maintained up to man.

The musculus triangularis of the gorilla represents the inferior labial portion of the lateral superficial layer of the musculus orbicularis oris. It consists of two portions, of which a lateral fixes the limits of the whole orbicular muscle and lateral to the corner of the mouth covers the other portion. The superficial lateral portion comes from the maxilla, runs under the maxillo-labial, the zygomatic, and superior labial bundles of the platysma. The bundles run medially and downward and end as a sheet 8 mm. wide about 8 mm. from the margin of the mandible in the strong subcutaneous fascia which is closely united with the platysma. Below the angle of the mouth the triangular muscle is crossed at intervals by fibers of the platysma.

The deeper portion of the triangular muscle spreads out in the lower lip medial to the superficial portion. It comes like the former from the maxilla and forms above the corner of the mouth only a deep layer of the pars caninus of the orbicular system. At the level of the corner of the mouth a bundle of the orbicular muscle 1 mm. wide runs into it from the upper lip. This inserts on the upper lip between bundles of the maxillo-labial into the skin. Through this the direct connection of the pars caninus with the pars orbicularis is retained.

In spite of the attachment to the strong subcutaneous fascia, it is only conceivable that the triangular muscle of the gorilla can draw down the corner of the mouth if it can contract independently of the canine. Its action, however, seems to be one with that of the canine and because of the curved

course around the angle of the mouth must aim at drawing the angle forward. In no respect does the musculus triangularis of the gorilla attain a very great degree of independence, as it represents only superficially inserting bundles of the pars caninus and pars orbicularis.

5. *Musculus caninus of Simia*

The canine muscle of the orang is well developed and has a width of about 10 mm. It is covered by the musculus maxillo-labialis and more superficially by the muscoli levator labii alaeque nasi and orbito-labialis.

It takes origin along an oblique line below the infra-orbital foramen. The lower fibers extend slightly farther forward than the upper.

The fibers at first pass laterad, backward and downward, and then almost directly downward as far as the angle of the mouth. A few bundles then continue forward to end in the lower lip.

Musculus caninus of Anthropopithecus. The anterior or medial edge of the canine muscle of the chimpanzee is nearly horizontal and adjoins the orbicular muscle of the mouth. The direction of the fibers is the same as in the latter, but nearly at right angles to those of the nasal muscle. The posterior edge is almost vertical. The muscle reaches the upper edge of the orbicular and at the same time that of the zygomatic 6 mm. behind the angle of the mouth and has at this point a width of 6.5 mm. The "intermediate bundles between the orbicularis oculi and the zygomaticus" and the musculus levator labii superioris must be reflected before the caninus can be seen. Upper fibers of the canine turn abruptly toward the surface passing between fibers of the 'intermediate bundle' to the skin. The remainder after bending downward lateral to the angle of the mouth go over into the musculus orbicularis oris of the lower lip and into the triangularis.

At the intersection with the zygomatic the muscle divides into layers in a manner described under that muscle.

The superficial layer of the canine takes part in the formation of the triangular muscle. "How the deeper layer ends I have not been able to determine" (Virchow).

Musculus caninus of Gorilla. The pars caninus of the gorilla consists of four muscle layers, of which the two superficial pass over into the musculus triangularis. The most superficial layer is about 4 mm. wide and is continued entirely into the triangular. The second layer is 5.5 mm. wide. From it a superficial layer 2 mm. wide releases itself as the deep medial layer of the triangular. A lateral bundle of similar width ends at the corner of the mouth upon a deep portion of the platysma. Medial muscle parts covered by parts of the triangular form a third layer. They can be followed as a strip 3.5 mm. wide from the maxilla to the lower lip, where they are connected with the orbicular fiber system. They continue to the midline where the interweaving of a few bundles occurs. A deep fourth part is formed from the superior labial bundles which break through the maxillo-labial and in part are continued into the triangular.

The canine and triangular muscles manifest a common action in pulling the corner of the mouth forward. An accessory action of the canine is to raise the corner of the mouth and the lower lip.

6. *Musculus buccinatorius of Simia*

The buccinator muscle of the orang presents more difficulties in its analysis than any of the other muscles, with the exception of the orbicular muscle of the mouth. Most of the detailed descriptions of its insertion are complex and unsatisfactory. The present description will be no exception.

The muscle is attached to the maxilla as far forward as a plane between the first and second deciduous molars. The line of attachment passes backward along the maxilla, along the pterygomandibular raphé to the mandible and forward on the mandible to the plane of the first deciduous molar.

The bundles coming from the anterior part of the maxillary attachment first run upward, then curve on themselves to run

downward and forward to the angle of the mouth. The posterior bundles have a similar course, but are directed more sharply forward.

The bundles from the upper part of the pterygomandibular raphé run directly forward to the angle of the mouth and lower lip. The next group of fibers from the raphé pass first laterad and then forward to the angle of the mouth and upper lip. From the lowest part of the raphé fibers pass forward and upward and then curve forward into the lower lip. A few bundles having an origin from the anterior end of the mandibular attachment curve downward, then upward toward the angle of the mouth.

Rex states that the buccinator muscle has important insertions into the mucosa and in the lower lip passes beyond the midline to decussate with the muscle of the opposite side.

Musculus buccinatorius of Anthropolithecus. While any separation of the muscle into parts or layers is arbitrary in the chimpanzee, it is convenient to recognize three portions, 1) a horizontal or principal portion, 2) an upper anterior descending portion which is superficial, and, 3) a lower anterior ascending portion which is deep. For the sake of clearness, there may be separated off from the first portion an upper marginal portion and a lower marginal portion. It should be noted again that none of these parts are independent. The greatest independence is obtained by the lower vertical ascending portion.

1. Horizontal or principal portion. *a.* The upper marginal portion. This upper posterior part has a horizontal direction. It arises posteriorly on the bone. The maxillary origin of the buccinator extends from the posterior end of the maxilla to the middle of the alveolus of the first milk molar. Along this line three parts of different character are to be differentiated. The origin of the upper marginal part is limited to the posterior end of the line.

b. Chief portion. The chief portion is continuous with the upper marginal bundle, but the character of the muscle is changed. It has here the appearance of a network of coarse

bundles. Many bundles converge into thicker bundles and then diverge again.

The part adjacent to the orifice of the parotid duct is horizontal; this is followed below by a part with an oblique course in that its posterior end is somewhat the higher. A further part of the chief portion which arises from the lower marginal portion will be described with the latter. In the region of the angle of the mouth where it approaches the *musculus orbicularis oris* the buccinator is very thick and is made up of fine fibers so that here the muscle is recognized only with difficulty. In this region a portion lying below the plane of the mouth ascends slightly; it covers the fibers extending forward horizontally above the plane of the mouth, but is itself again covered by the upper oblique portion to be described (2). This oblique ascending portion goes in part to the upper lip. The posterior origin of the chief portion is assumed to come from the pterygo-mandibular raphé as in man.

If one follows the chief portion into the depth as he gradually removes the superficial bundles he finds its character altered, the coarse-bundle plexiform nature is lost, and the muscle takes on a uniform fine-fibered appearance. The muscle is in close relation to the mucosa, but is only attached to it by individual thin bundles.

In the lower lip a part of the buccinator piercing through a deep layer of the platysma comes to lie anterior to this and is continued in relation to the orbicular muscle of the mouth.

c. Lower marginal portion. In the lower marginal portion a horizontal direction of the fibers is present. The structure is complicated, however, by individual bundles which ascend obliquely and become superficial. The lower marginal portion does not arise from bone, but from mucosa very near the bone. This origin extends forward to a plane between the first and second deciduous molars. The oblique bundles pass up into the chief portion. The horizontal bundles insert partly into the bone and partly into the mucosa. The bony

insertion on the left is along a line 12 mm. long extending to the alveolus of the first premolar. The insertion into the mucosa may be as far forward as the lower canine. There is a small bundle constricted at the middle which is continuous at one end with the buccinator and at the other with the mental.

2. Upper oblique descending portion. This is not entirely independent, but goes over dorsally through a gradual change in the direction of its fibers into the chief portion of the buccinator. It was observed above that the origin of the buccinator on the maxilla consisted of three parts. Of these the two anterior belong to the upper oblique portion. The fibers of the latter run obliquely downward and forward toward the angle of the mouth. The more anterior it becomes the more vertical are the fibers. The upper oblique portion at its lower end goes about equally into the upper lip and into the lower lip. Bundles could be traced into the upper lip and were found to run almost parallel to the rima oris. At the angle of the mouth this portion is pierced by a very thin layer of the orbicular so that it is divided into a superficial and a deep layer. The upper oblique portion lies directly upon the mucosa for a distance of 3 mm. from the fornix of the mucosa, then a bundle of the orbicular 2 mm. wide pushes in between them.

3. The lower vertical ascending portion. The anterior margin is sharply marked off. This edge begins behind the angle of the mouth and reaches below to the middle of the alveolus of the first premolar if we only consider its bony attachment. The bony origin has a width of 6 mm. from this point posteriorly. Several small bundles arise from the mucosa in front of the bony origin and pass upward and backward to blend with the anterior end of the muscle.

The anterior part of the portion under consideration is compact and strong; at the level of the angle of the mouth the width is 6 mm. and over the gland zone, 8 mm. The bundles attaching farther back have a more and more oblique position which approaches the horizontal, and finally go over into the horizontal or chief portion.

In the region of the mouth the buccinator may be divided into five layers; the upper oblique portion is most superficial, then follows a segment of the chief portion which ascends obliquely to the angle of the mouth, then a horizontal segment of the chief portion, under this the lower ascending portion, and finally between this and the mucosa another layer of the chief portion.

Musculus buccinatorius of Gorilla. In the gorilla this is a broad, strong muscle layer which has an origin near the mucosa beginning at the jugum alveolare of the first upper premolar tooth and extending backward on the maxilla onto the pterygomandibular raphé and over onto the mandible.

The anterior bundles arising on the maxilla run sharply downward, assemble at the angle of the mouth, and extend into the lower lip. The stronger bundles of origin lying farther back and pierced by the parotid duct unite in the region of the maxilla with bucco-labial bundles of the orbicular system, but below run more sharply downward than the orbicular fibers and are prolonged even to the mandible. Here they attach to the jugum alveolare of the first premolar tooth and extend backward for 18 mm. The lower marginal bundles arise from the lower jaw and also insert onto it.

The action of the principal layer of the buccinator can only be tension of the buccal mucosa. The anterior fibers from the maxilla may raise the angle of the mouth.

A deep strong layer of the buccinator is found in the upper lip. It forms a margin 4 mm. wide on the rima oris, and with part of the orbicular muscle of the mouth forms the so-called 'marginal ridge' of the lip.

7. *Musculus mentalis of Simia*

The mental muscle of the orang is well developed; it is both broad and thick. It has an origin on the mandible on the juga of the incisor teeth. It passes downward to insert on the skin of the chin spreading out, so that it becomes broader toward its insertion. The muscles of the two sides

interdigitate somewhat with each other and with the platysma before reaching the skin attachment.

A few coarse bundles from the upper part of the origin pass laterad and downward in the interval between the main part of the mental muscle and the lower margin of the buccinator. They end in loose connective tissue deep to the inferior quadratus muscle.

Musculus mentalis of Anthropopithecus. This muscle of the chimpanzee is 15 mm. wide at its origin. The insertion into the skin appeared to be 13 mm. high in the sagittal plane. The superficial layer of the platysma lies between the skin and the muscle so that the mental bundles can only reach the skin between the platysma bundles. Some bundles, especially the lateral ones, probably do not reach the superficial area.

The medial half of the muscle on each side runs downward and somewhat mediad so as to join its fellow of the opposite side at an acute angle below. There is a decussation that reminds one of the human platysma behind the chin. The deepest layer is a bundle 2.5 mm. wide from the right side, in front of this is a bundle 5 mm. wide from the left side, then a bundle 6 mm. wide from the right side, and in front of this again a bundle 6 mm. wide from the left side.

Between the right and left muscles is a space containing adipose tissue.

On the posterior surface of the mental muscle is a bundle which has the same direction as the platysma bundles. The lateral part of the muscle is weaker than the medial, and the bundles diverge so that the most lateral ones have the direction of the buccinator, that is, horizontal.

The bundles of the mental adjoining the posterior surface of the platysma for the most part insert by small tendons into this surface, but there is some interweaving with the platysma.

The penetration of the platysma bundles into the field of origin of the mental muscle has been described with the former muscle.

Musculus mentalis of Gorilla. The mental muscle is strongly developed in the gorilla. Its origin is near the mucosa of the juga alveolaria of the incisor teeth and by a second slip from the jugum of the canine. The origin is covered by the inferior labial bundles of the platysma.

The fibers pass from deep to superficial to insert into the chin, into the streak of skin not occupied by the platysma. Bundles of the platysma and mental muscles interweave. In the midline the mental muscles of the two sides decussate. The muscle may be separated into three layers.

8. *Musculus orbicularis oris of Simia (and relations near the angle of the mouth)*

In the orang we found very few truly orbicular fibers, that is, fibers which run around the angle of the mouth from one lip into the other. We will describe with the *musculus orbicularis oris* all the bundles which lie in the lips.

In general the more superficial bundles in each lip are continuations of muscles which radiate from the mouth. These bundles do not curve to become parallel with the rima oris, but maintain their radial direction.

The deeper bundles lie parallel to the rima oris. These arise either as continuations of buccinator bundles or from fascia at the angle of the mouth. Mediad they extend to or beyond the midline interweaving with those of the other side.

Intermediate in depth are found a few bundles which have a circular or subcircular course around the angle of the mouth. It is to be noted that the radial muscles as they approach the angle of the mouth all converge to a third or less of the width at their origins.

The exact course and relations of the various muscles as far as could be determined by careful dissection under water will now be described for each muscle contributing to the musculature of the lips.

Musculus orbito-labialis. This muscle is superficial in the upper lip. It approaches the margin of the lip just medial

to the angle and inserts into the skin. A few of its bundles interweave with platysma bundles above and lateral to the angle of the mouth. Other bundles interweave with the muscoli maxillo-labialis and levator labii alaeque nasi near their insertion.

Musculus maxillo-labialis. This is superficial in the upper lip, but is crossed obliquely from medial to lateral by bundles of the *musculus levator labii alaeque nasi*. It is placed just mediad to the orbito-labial.

Platysma. Some bundles of this muscle run toward the angle of the mouth just superior to the triangular. Superficial bundles interweave with the orbito-labial. The deeper bundles interweave with the canine muscle and appear to end in its substance.

Musculus quadratus labii inferioris. The deep bundles of this muscle interweave with the orbicular muscle in the lower lip mediad to the triangular and end in its substance.

Musculus triangularis. There is continuity between the triangular and canine muscles by means of a small bundle which pierces the platysma. Superficial bundles converge to the angle of the mouth. Most of the deep bundles of the triangular appear to end opposite the angle of the mouth at the same depth as the canine bundles and meeting the latter almost at a right angle. These bundles are deep to the orbito-labial, to orbicular bundles passing to the buccinator, and to superficial bundles of the triangular itself.

Musculus caninus. A superficial bundle of the canine runs through the platysma and can be traced for a short distance below the angle of the mouth into the lower lip. Another bundle is continuous with the triangular as described under that muscle. The remaining bundles appear to end at the angle of the mouth in the same region as those of the triangular. Some of the latter interweave with upper bundles of the buccinator.

Musculus buccinatorius. The more superficial bundles can be traced only to the angle of the mouth. The deeper bundles end in the following manner: Inferior bundles curve up into

the orbicular bundles of the lower lip which lie parallel to the rima oris. The other deep bundles below the angle of the mouth pass up by the angle and become continuous with marginal bundles of the upper lip. Bundles lateral to and slightly above the angle pass into and become continuous with marginal bundles of the lower lip. More superior bundles could be traced only to the angle.

Bundles parallel to the rima oris. *a*) Superficial bundles. Marginal bundles end at the angle of the mouth. Peripheral bundles of the lower lip curve up adjacent and parallel to the triangular and end as do some bundles of the latter at



Figure 2

the angle of the mouth. Some intermediate bundles of the lower lip become tendinous at the angle of the mouth, then continue into the upper part of the upper lip, there again becoming parallel to the rima oris. More than one bundle may pass to a single tendon as indicated in figure 2. These are the only fibers which we found to run actually around the corner of the mouth from one lip into the other. They are not superficial at the corner of the mouth, but are overlain by bundles in the lower lip which are continuous into the platysma and by bundles which end at the angle. The greater part of the intermediate bundles of both lips end at or near the corner of the mouth. *b*) Deep bundles. Marginal bundles of the two lips interweave at the corner

of the mouth and pass into the buccinator. Most of the remaining deep bundles from the lower lip also continue into the buccinator. Peripheral bundles of the upper lip could be traced only to the angle of the mouth.

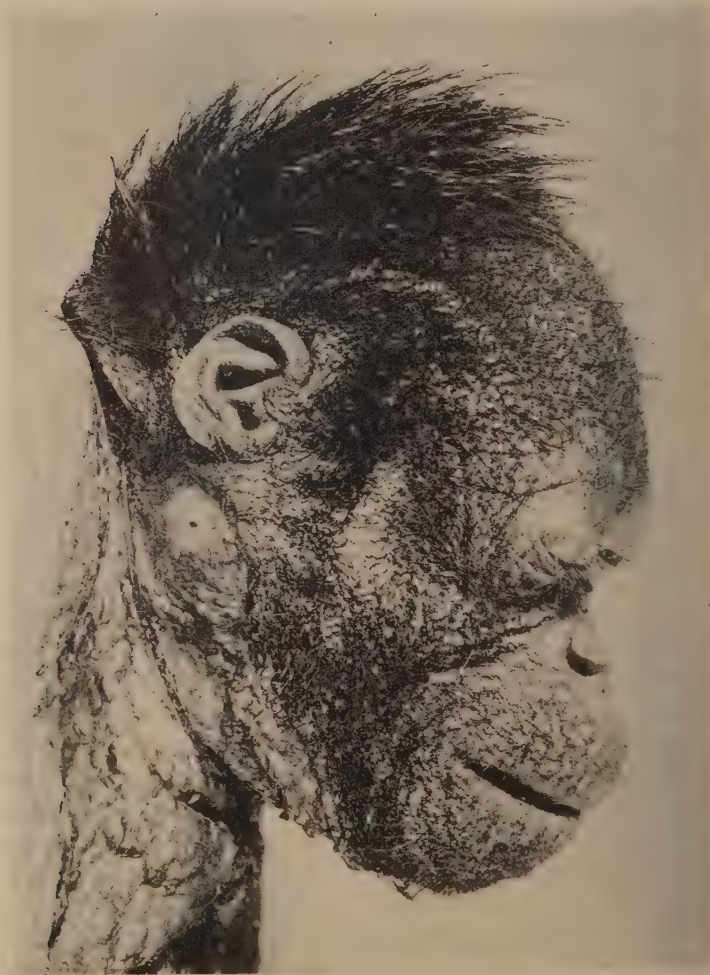


Fig. 3 Orang (Simia). Photograph by Walter J. Meek.

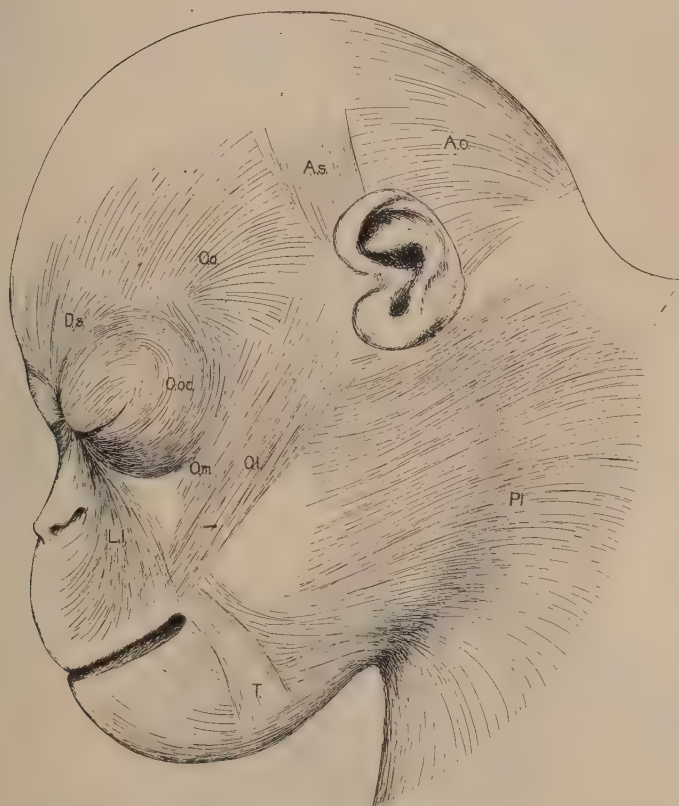


Fig. 4 Orang (Simia).

ABBREVIATIONS

<i>A.a.</i> , auricularis anterior	<i>O.a.</i> , orbito-auricularis
<i>A.a-s.</i> , auricularis anterior et superior	<i>O.l.</i> , orbito-labialis
<i>A.o.</i> , auriculo-occipitalis	<i>O.m.</i> , orbito-malaris
<i>A.p.</i> , auricularis posterior	<i>O.oc.</i> , orbicularis oculi
<i>A.s.</i> , auricularis superior	<i>Pl.</i> , platysma
<i>D.s.</i> , depressor supercillii	<i>Pr.</i> , procerus
<i>L.l.</i> , levator labii alaeque nasi	<i>T.</i> , triangularis
<i>M.l.</i> , maxillo-labialis	<i>Z.</i> , zygomaticus
<i>N.</i> , nasalis	

Musculus orbicularis oris of *Anthropopithecus*. In the upper lip of the chimpanzee in the midline the muscle has a width of 21 mm., at the angle of the mouth, 9 mm., and in the middle of the lower lip, 32 mm. The greatest width in the

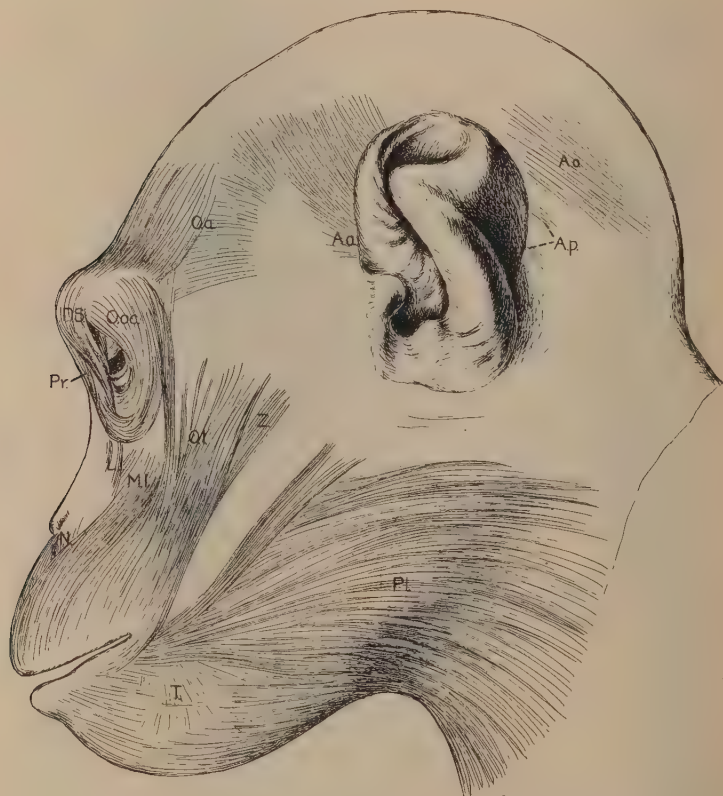


Fig. 5 Chimpanzee (*Anthropopithecus*), copied from Dr. Hans Virchow, 1915.

lower lip is found only in a superficial layer; the deep layer is only 25 mm. wide. The exact borders of the orbicular muscle are indefinite.

In the upper lip the orbicular muscle is entirely covered by the spreading out of the zygomatic, the intermediate

bundles and levator of the upper lip; in the lower lip it is entirely covered by the superficial layer of the platysma. The deep surface of the muscle lies toward the mucous membrane,

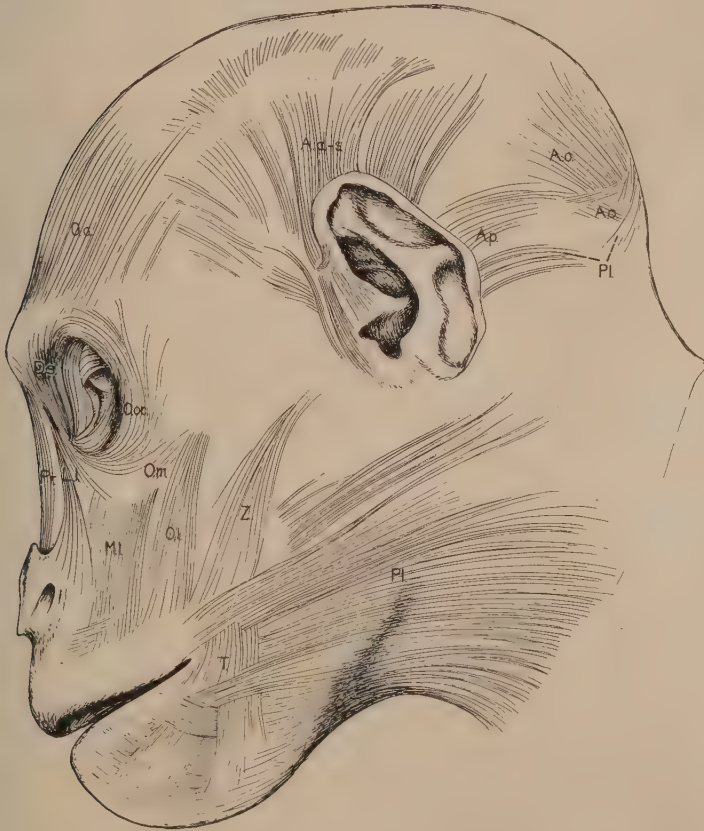


Fig. 6 Gorilla (Gorilla), copied from Georg Ruge, 1887.

but between the two there is a considerable layer of connective tissue.

The superficial bundles are united in a plexiform manner with the neighboring muscles. The deep bundles have the parallel arrangement which is usual for most of the facial muscles.

At the lower edge of the muscle is seen a portion which overlies the platysma, but at the upper edge of it the platysma breaks through. This part lies below the lip region proper and reaches to the midline. It comes from a layer at the angle of the mouth which is not superficial. This indicates that it is to be regarded as part of the orbicular rather than of the triangular muscle.

A bundle to the buccal mucosa. One bundle of the orbicular muscle lying in the upper lip half-way between the rima oris and fornix of the mucosa on the inner side of the muscle extends to the mucosa. It is at first separated from the mucosa by glands and connective tissue, but at the place where the zone of glands is cut down and where the upper oblique portion of the buccinator begins, the bundle runs deeply, spreads out, and ends in the mucosa.

Musculus orbicularis oris of Gorilla. Under the heading "system of the musculus orbicularis oris," Ruge has described for the gorilla the musculus triangularis, musculus caninus and "pars orbicularis = pars bucco-labialis." We have already discussed the muscoli triangularis and caninus and will now describe what he terms "pars orbicularis = pars bucco-labialis" in the gorilla. But little if any of his thought is lost in thus breaking up the description. The interpretation of the findings given below is based on the assumption that the orbicular fibers are the more primitive. The history of the canine and triangular muscles support this assumption.

The pars orbicularis and pars bucco-labialis may be considered together, as they are found in the closest genetic relationship. As a pars orbicularis it is considered as fibers which pass from the upper lip around the corner of the mouth to the lower lip. At the angles of the mouth they are more strongly bent than fibers from the canine or triangular. These latter form a wider arc. As a pars bucco-labialis it is considered as fibers which have wandered out from the upper and lower lips into the cheek. The two parts have remained in close relationship with the canine in the lower lip. Their genetic relationship with bundles of the upper lip is shown by

the part which breaks forth through the bundles of the maxillo-labial muscle.

After the removal of all of the layers of the canine a great series of laterally deviating bundles appear which in the cheek become associated with the buccinator. These constitute a bucco-labial portion. The deeper orbicular fibers, therefore, abandon their orbicular course completely and pass from the upper or lower lip to the mucosa of the cheek. Bundles which pass from the lower lip to the maxilla may, if they pass to the juga alveolaria of the incisor teeth, be considered a *musculus incisivus labii superioris*.

The whole upper lip is covered by strong parallel muscle bundles of the orbicular system from the rima oris to the fornix of the mucosa. We may distinguish deep and superficial layers. The deep layer, 4 mm. high, passes not to the lower lip, but to the cheek. It is part of a primitive buccinator. The superficial layer inserts between the rima oris and the line of insertion of the *musculus maxillo-labialis* and also medial to this into the subcutaneous fascia. The fibers reach the midline and beyond, and interdigitate with those of the opposite side. The upper bundles attach to the maxilla, near the mucous membrane, on the juga alveolaria of the incisor teeth.

After the removal of the canine one small bundle is seen to run horizontally backward and end 12 mm. lateral to the corner of the mouth upon a deep portion. Other superior labial bundles of the orbicular run around the angle of the mouth to the lower lip and joining very closely with the canine muscle end in the subcutaneous tissue. One can follow deeper bundles of this muscle zone from the lower lip, where they are attached to the skin, upward and backward lateral to the angle of the mouth into the cheek. Several small superior labial bundles deeper than those last described run into the cheek. Under these a strong muscle sheet spreads out. This arises with a base 19 mm. long from the maxilla near the mucous membrane and sends converging bundles toward the

angle of the mouth. Deep to this are circular fibers which extend as far as and beyond the midline both in the upper and lower lips. Some of the inferior labial bundles are displaced posteriorly at their upper ends and become bucco-labial.

There is a still deeper layer which has retained its relation to the lower lip, but runs from there to the cheek. It covers the lower lip at the angle of the mouth for 5 mm. downward from the rima oris. Farther anteriorly it spreads out over the whole lower lip and reaches the upper fibers of the mental muscle. The bundles of the two sides cross in the midline. This layer has lost its orbicular course and runs backward and upward to blend with the buccinator in common with which it attaches to the maxilla.

All orbicular parts which have been displaced laterally to the region of the cheek agree in that, through intimate fusion with the buccinator, they better produce a distinct mobility of the corner of the mouth and lips.

Ruge says: "The relations around the corner of the mouth are most complex in the gorilla, somewhat less so in the chimpanzee and much simpler in the orang than in either of the others." Our study of the orang would lead us to believe that, but little could be added to the complexity found in that animal.

Comparative studies show that the orbicular is an independent muscle and that the triangular and canine are derivatives of it. The interrelations of the orbicular and buccinator muscles are not clear, but it appears that in the anthropoids each contributes to the definitive formation of the other.

SUMMARY

The facial muscles of the anthropoids are complex and especially so in the oral and interorbital regions. We have not had enough material to warrant much generalization, but a few points seem well enough established to warrant our mentioning them here. Some of the more interesting features have been mentioned in the introduction.

The platysma of the orang has retained more of its nuchal and deltoid portions than that of either the chimpanzee or gorilla. In addition, it has a direct attachment to the acromion. The *musculus quadratus labii inferioris* is essentially the same in all three animals.

The epicranial musculature of the orang is in two layers in the occipital region. The epicranial fascia is also in two layers. This condition is not described for the chimpanzee and gorilla. The orbito-auricular muscle of the orang has a very definite attachment to the frontal bone; in the chimpanzee the attachment to the bone is weak or absent; in the gorilla the attachment in front is in part to bone, in part to fascia. While there is an occasional conflicting statement, it appears that the epicranial region of the chimpanzee has more fibrous and less muscle tissue than that of the orang and gorilla.

The extrinsic muscles of the ear are found in varying degrees of independence.

The orbicular muscle of the eye of the orang has its marginal bundles attached to the lateral orbital wall through a strong tendon. This condition has not been described for the chimpanzee and gorilla. A muscle of Horner was not definitely isolated, but this may have been due to faulty technique. No well-marked lateral palpebral raphé has been found in the orang or gorilla: one has been described for the chimpanzee. The *musculus corrugator supercilii* is absent from the orang, present in the chimpanzee, and represented weakly in the gorilla. The *musculi depressor supercilii* and *procerus* are present in all three animals. In the orang the *procerus* is not readily separable from the *musculus levator*

labii alaeque nasi. In general it should be said that the condition in the interorbital and dorsal nasal regions is complex and there is abundant opportunity for different interpretations of structures that are quite similar.

The musculature of the lips of the orang is intricate. During life this is correlated with a very high degree of mobility.

The zygomatic muscle is absent from the orang; that of the chimpanzee has been described as having deep bundles of insertion, while that of the gorilla has not. The musculi orbito-labialis et orbito-malaris have no attachment to bone with the exception of a few deep bundles of the orang. In the chimpanzee and gorilla they occupy the space between the zygomatic muscle and the orbicular muscle of the eye; in the orang they are adjacent to the orbicular muscle. The maxillo-labial muscle is very much the same in all three animals, although that of the orang seems to have the most extensive origin. The triangular muscle is best developed in the orang. Here we find a direct attachment to the mandible. In the chimpanzee it has been described as very weak and thin; in the gorilla it attains no great degree of independence of the canine. The canine muscle is also best developed in the orang. The buccinator muscle is very complex in all three animals, but the attachments are essentially the same.

To us the most striking thing in the lips of the orang was the paucity of truly orbicular fibers. This has been discussed in detail under the orbicular muscle of the mouth. We feel that the exact condition in the lips of the anthropoids is far from being clearly demonstrated.

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PROCEEDINGS OF THE TWENTY-SECOND ANNUAL MEETING OF THE AMERICAN SOCIETY OF ZOÖLOGISTS

WASHINGTON, D. C., DECEMBER 29, 1924—JANUARY 1, 1925

The 1924 program of the American Society of Zoölogists was carried out practically as announced in the preceding number of this Journal. All the regular officers of the Society and one additional member of the Executive Committee were in attendance. The day sessions were held in the Central High School Building, as were the meetings of all other biological societies.

Thanks to the efficient efforts of the Local Committee, the inconvenience caused by holding meetings in a high school rather than in university buildings was greatly reduced. The facilities available in such a building are not, however, readily adaptable to the physical requirements for the most successful meetings. This was also the experience of the Society at St. Louis.

In numbers attending the different sessions, this was the largest meeting in the history of the Society. The usual meeting room with 150 seats was well filled at all meetings and usually as many more were inspecting exhibits and conferring in the corridor outside. Unfortunately, the seating arrangement did not allow for a ready shifting of attendance as the subject-matter shifted during the long sessions.

THE PROGRAM

In the following summary the papers will be referred to by the number which they bore in the list published in the December number of this Journal.

MONDAY, DECEMBER 29TH

10:00-12:40 President Harrison presiding.

General and Comparative Physiology. Papers 1 to 16 were presented, 4, 7, 11, and 12 by title. By vote, the reading of the papers as arranged was authorized. This allowed papers on the same division of physiology to be called together.

2:05-5:00 President Harrison and Vice-President Linton of Section F presiding.

General and Comparative Physiology, concluded, and Endocrinology. Papers 17 to 33 were presented, 24, 27, 28, and 29 by title. When it became apparent that the program of the day would be too long, the Society voted to continue in session until 5:00 and to read introduced papers following no. 25 by title only (see by-law 7 e).

6:30 Informal dinner conference on the teaching of zoölogy, with particular reference to the aim of the elementary college course. President Harrison introduced as presiding officer H. S. Colton, who had initiated and arranged the speaking program for the conference. After brief talks by D. E. Minnich (vice C. P. Sigerfoos), A. F. Shull, R. A. Budington, and E. G. Conklin, there was general discussion until adjournment at 9:00. 135 attended.

10:00-12:00 P.M. The Biological Smoker was held simultaneously with the opening reception of the American Association for the Advancement of Science in the National Museum Building. The arrangements for the smoker were initiated by the Union of American Biological Societies and was financed by the biological societies of Washington.

TUESDAY, DECEMBER 30TH

9:15-1:00 President Harrison presiding.

Endocrinology, concluded, Cytology and Embryology. Papers 34 to 61 were presented, 34, 38, 43, 45, 50, 51, 52, 58, 60, and 61 by title. By consent of the Society, Doctor Swingle gave the time allotted to his paper to his students, O. M. Helff and R. L. Zwemer, who presented their introduced papers. No. 39 was passed to be presented in the general session in the afternoon.

2:00-3:20 Vice President Linton of Section F presiding.

Papers by N. M. Grier and Harold Heath (nos. 39 and 63) were presented in full and one by H. F. Osborn, by title, but the principal speaker was E. L. Rice, retiring Vice-President of Section F, on "Darwin and Bryan: A Study in Method." Probably a thousand people were present.

3:20-3:30 Business meeting of Section F.

3:30-5:45 Business session of the Society. President Harrison presided. Attendance varied from 125 at the beginning to 50 at the end.

WEDNESDAY, DECEMBER 31ST

9:07-12:10 Vice-President Nabours and President Harrison presiding.

Protozoology and Parasitology. Papers 64 to 77 were read, no. 67 by title. The Society voted to continue the Parasitology program in the afternoon in special section conflicting with the symposium and ordered all introduced papers on these subjects to be read in full.

2:00-5:00 Symposium. Sex determination and sex differentiation. President Harrison presiding.

Sex determination and sex differentiation in the higher plants. John H. Schaffner, Ohio State University, representing the American Society of Plant Physiologists.

Sex in relation to chromosomes and genes. Calvin B. Bridges, Columbia University.

Sex and the parthenogenetic bi-sexual cycle. A Franklin Shull, University of Michigan.

The problem of sex differentiation. W. W. Swingle, Yale University.

Sex determination and differentiation in birds and mammals. Carl R. Moore, University of Chicago.

Attendance 500.

PARASITOLOGY SECTION

The Secretary called W. W. Cort, Secretary of the newly formed Parasitology Society, to the chair. Papers 78 to 89 were presented, nos. 81, 82, and 84 by title. The maximum attendance was 50.

7:20-9:30 Annual Zoölogists' Dinner. Hotel Raleigh.

Retiring President M. F. Guyer gave the address on "Soma and Germ." Edwin Lindon and W. C. Allee were introduced to give brief talks in a lighter vein.

THURSDAY, JANUARY 1, 1925

9:20-12:20 Joint session with the Ecological Society of America. Vice-President Allee of the Ecological Society presided. Papers 90 to 101 as listed on the Zoölogists's program were read, no. 90 by title, and in addition the following papers were presented:

- a. Experiments on the reproduction and development of cysts in the California brine shrimp, *Artemia*. Helen H. Greene and Ernest C. Martin, Stanford University.
- b. *Bothriocephalus* of the white fish. (10 min.) Emmeline Moore, New York State Conservation Commission.

This disease has been observed among the Adirondack frost fish (*Coregonus quadrilateralis*). The larval tapeworm (*Bothriocephalus* sp., Linton) perforate and preempt the sinus venosus and clog the entering veins. Hemorrhage and clogging apparently induce the fatal lesion. This type of parasitism involves another host, the cat, dog, or man being the definitive host harboring the adult stage of the tapeworm.

After the luncheon of the Ecological Society, the joint program was concluded by reading two more papers.

- c. Reactions of marine amebas to varying concentrations of sea-water. A. A. Schaeffer, University of Kansas.

The general assumption that the normal concentration of sea-water is the optimum concentration of marine animals is found not to be true of several species of marine amebas, as measured by the rate of movement. The amebas

so tested belong to three different families, and the results for each species are of unexpected definiteness. There is evidence that some substance is destroyed in the ameba by transferring from normal to optimum concentrations and the reverse. The difference between normal and optimum concentrations of sea-water seems to vary in the different species in accordance with the maximum amount of dilution the amebas can withstand. There is some evidence that similar relations hold true for at least some ciliates.

d. Carbon-dioxide production in low oxygen tensions in fresh-water clams. Arch E. Cole, Northwestern University.

Certain fresh-water clams, *Anadonta grandis* and *Anadontoides ferussaciana*, were found to be capable of living sealed in jars of water whose oxygen tension was so low that they could utilize none of the remaining oxygen. Under these conditions they continued to produce CO_2 as is evidenced by measurements both of the free CO_2 in the water and also of the carbonates and bicarbonates of the coelomic fluid. The clams are quite active during this period, which indicates that a considerable amount of energy is being liberated. That oxygen for the liberation of this energy is not stored by the clam is indicated by the fact that they are capable of living for two weeks or more under these conditions. It is thought that a partial splitting of the carbohydrates in the absence of oxygen would not furnish sufficient energy, as is shown by the heat equivalent values of the end products of the splitting. The presence of an enzyme complex capable of oxidizing alcoholic tincture of guaiacum without the addition of hydrogen peroxide even in low oxygen tensions may offer a possible solution of the problem. That this is a very unusual enzyme in animal tissues, together with the fact that I have located similar enzymes in other animals which are capable of living in low oxygen tensions, adds considerable weight to this latter hypothesis.

In all ninety-three papers were given in full and twenty-three by title. Despite the crowded condition of the program, there was usually comment, question, or very brief discussion following each paper.

BUSINESS MEETING

At the business session the following report of S. I. Kornhauser as representative of the Society on the Executive Committee of the Commission on Standardization of Biological Stains was accepted and Doctor Kornhauser was continued in this capacity.

The work on stains has been continued during 1924, and it is felt that even greater progress has been made than during any preceding year. In the first place, the plan of certification has been extended to cover a much larger series of stains than in the past. Batches of the following stains tested and approved by the Commission are now available from different companies: orange G, basic fuchsin, crystal and gentian violet, acid fuchsin, pyronin, eosin, methylene blue, safranin, and haematoxylin. It is expected that before the winter is over the

following dyes will also be put on this same basis: methyl green, anilin blue (water solution), methyl orange, Sudan IV, Bismarck brown, light green (S. F. yellowish) thionin, toluidin blue, Azur I, and Wright's stain. This list, as will be seen, embraces practically all of the dyes that are found in practically every biological laboratory. The other stains are ones which are used for special purposes only, and we will work on them after we have put all of the important stains on the certification basis.

In one other line progress has been made during the present year. The first draft has been drawn up of a book on biological stains. This book is to discuss for biologists the chemistry of stains, going to considerable length into their synonymy and their most important uses in microscopic technic. It is not to be a text-book in histology, but it is hoped that it will prove a guide to the histologist in the selection of stains for any piece of technic which he may have in mind to adopt. It will be some time yet before this book is ready for publication, because some of the last things still to be done to it are time consuming, but it will probably be out some time during 1925. At the same time work is being done on the preparation of a popular pamphlet or book on dyes in relation to public health. This is also hoped to be published some time next year.

Cooperation with industrial concerns is still proceeding much as before and in general in a satisfactory way. Eight different dealers in general laboratory supplies have contributed to our support, and it is hoped they will continue this support another year. These companies are: Braun-Knecht-Heiman Co., Denver Fire Clay Co., E. F. Mahady Co., E. H. Sargent Co., Scientific Materials Co., Arthur H. Thomas Co., and the Will Corporation. All of these companies have expressed their willingness to carry certified stains as rapidly as they are put upon the market.

In regard to the companies specializing in stains, the situation is much as it was before. We still feel that the products of the National Anilin and Chemical Company and those of the Empire Biochemical Company are particularly to be recommended. Coleman and Bell still refuse to cooperate, and as a result none of their products have been certified. In some cases their stains are very good, however. This is particularly true in the case of the most commonly used stains, as for example pyronin; their products have sometimes been found very poor and even quite different from what they are labeled.

A new factor has now entered the situation in that the LaMotte Chemical Products Company has entered the field and are planning to put a line of biological stains on the market. None of their products have yet been submitted to us, but from the general reputation which this company has, we have every reason to think that theirs will be a satisfactory line.

Your representative was present at a meeting of the Executive Committee held at the Chemists' Club in New York on November 14th. Plans for the continuation of the work for the coming year were formulated, and arrangements partially effected for the publications already noted in this report. The support and encouragement of the Chemical Foundation will undoubtedly be continued. It was pointed out at the meeting that the work on the standardization of biological dyes being done by the army is in no way competitive of our work, but an attempt by the army to fortify itself in the purchase of dyes so as to exclude unsatisfactory products under the army purchase plans. The army is cooperating with our Commission through the services of Dr. J. A. Ambler.

Through the Secretary, V. E. Shelford reported that the \$25.00 granted by the Zoölogists at Toronto had enabled the Naturalists' Guide Publication Committee to classify the degree of modification of the faunas of natural areas and that the figures showing this modification in the forthcoming "Naturalists' Guide" should be regarded as the contribution of this organization.

The Secretary further reported that the membership of the society is composed of one Honorary Fellow, seven life members, 363 active members, and eight associate members. (After the election of new members this reads, 391 active and 25 associate members.) Eighteen members resigned in 1924, viz.:

G. N. Calkins	Nadine Nowlin
Wilson Gee	Henry Fairfield Osborn
Leland Griggs	Herbert Osborn
A. O. Gross	Florence Peebles
Maurice Hall	E. F. Phillips
C. W. Hargitt	Franz Schrader
L. V. Heilbrunn	A. H. Sturtevant
Ruth S. Lynch	E. N. Wentworth
S. Morgulis	E. E. Wildman

Elizabeth Peabody declined election, as she did not desire membership and had not been consulted before nomination last year.

W. A. Locy, A. MacGillivray, and G. A. Piersol died during the year.

This makes a total decrease in membership of twenty-two for the year. Later in the meeting forty-five new members were elected, which gives a net gain for the year of twenty-three and puts the total membership of the Society at the present time as 416.

Both resignations and elections were the largest in the last seven years. The majority of the resignations were caused by dissatisfaction with the journal arrangements with The Wistar Institute.

The new associate membership is appreciated, as evinced by the fact there were twenty nominations specifically for that membership. This membership can well be used to attach to the Society, young, promising research workers who may thus be kept in better touch with research currents in zoology. This is the more important in view of the high entrance requirements for active membership in the only research organization interested in the entire field of zoölogy.

Report of the Treasurer for the year 1924

Balance on hand last report, December 22, 1923.....	\$ 742.61
Receipts, December 23, 1923, to December 29, 1924.....	2898.86
Total cash handled during 1924.....	\$3641.47
Expenditures, December 23, 1923, to December 29, 1924.....	3017.97
Balance on hand, December 29, 1924.....	\$ 623.50

The funds of the Society are deposited with the Corn Exchange Bank of New York, N. Y., as follows:

Checking account	\$ 200.61
Savings account (including interest as of January 1st, 1925).....	422.89
Total	\$ 623.50

DETAILED STATEMENT

Receipts:

Balance on hand, January 1, 1924.....	\$ 742.61
Dues received (both current and arrears—and including payments for 1923 Programs and dues for Genetics Section both current and arrears)	2876.60
Receipts from sale of 1923 Programs at Cincinnati.....	9.00
Exchange and tax	.87
Interest as of January 1st, 1925.....	12.39
Total cash handled for 1924.....	\$3641.47

Expenditures:

Paid for current expenses of Secretary's Office:

Typing	\$ 99.44
Secretarial assistance	15.90
Printing	93.68
Miscellaneous	43.79
	\$ 252.81

	<i>Brought forward,</i>	\$ 252.81
Paid for current expenses of Treasurer's Office:		
Printing	\$ 35.38	
Exchange, postage, etc.....	27.05	
		62.43
Paid The Wistar Institute:		
Arrears up to January 1, 1924, voted by Society....	\$ 98.00	
1923 Programs	91.78	
Journal subscriptions	2396.50	
		2586.28
Refunds on overpaid dues	1.50	
Paid D. F. Jones, Secretary, dues for Genetics Section.....	61.00	
Paid H. H. Newman, expenses as Acting Secretary at 1923 meetings	40.58	
Paid Science Press for reprints of addresses by Professors Lazareff		
and Koltzoff	13.37	
Total expenditures	\$3017.97	
Total cash handled for 1924.....	\$3641.47	
Total expenditures for 1924.....	3017.97	
Cash balance on hand, December 29, 1924.....	\$ 623.50	

All bills received have been paid (with the exception of a small balance due the Genetics Section). In addition, four members resigned or dropped for non-payment of dues owe the Society \$37.00, which amount was paid The Wistar Institute on February 7, 1924, according to the vote of the Society at Cincinnati. Twelve members have not yet paid their dues for the year 1924.

ROBERT H. BOWEN, *Treasurer*.

DECEMBER, 29, 1924.

The books of the Treasurer were audited by E. A. Andrews and E. W. Gudger.

The report of the Secretary and the audited report of the Treasurer were accepted and ordered to be placed on file.

The Necrology Committee submitted minutes on the death of three members in the past year which were adopted by a standing vote, ordered spread on the records, and copies sent to the families of the deceased.

Minute on the death of Prof. W. A. Locy

In the sudden death on October 9, 1924, of William Albert Locy, Professor of Zoölogy in Northwestern University, the world has lost a noteworthy scholar, the American Society of Zoölogists a distinguished and honored member, and many of us a genial and loyal friend.

This is not the time nor place for a biographical memoir of Doctor Locy, but in recording in the minutes of the Society our sorrow because of his loss, it is not inappropriate to mention briefly his principal contributions to our science and his outstanding qualities as a man.

His technical researches were directed chiefly to major problems of the structure and development of the head and sense organs in vertebrates. His careful and accurate observations and the surprising conclusions to which he was led, served as a great stimulus to research in this field, and although these conclusions are still centers of controversy, some qualified students of the subject feel that he saw more of the truth here than have some of his critics. One of his major contributions was on the *nervus terminalis*; although he was anticipated in the discovery of this new cranial nerve, he was the first to furnish an accurate and comprehensive description of it, as well as the name by which it is known.

During the past twenty years, in addition to directing the research work of his students, his scientific contributions were devoted largely to the history of biology. In preparation for this work he visited many libraries, laboratories and museums of Europe, going to original sources, as far as possible, for his material and collecting large numbers of books, monographs, papers, and portraits of the founders of biology. His first book on this subject, "Biology and its Makers," was published in 1908 and is widely used in this and in other countries. Ten years later he published a volume, "The Main Currents of Biology," dealing with the principal theories and lines of progress of the science. At the time of his death he had just finished the manuscript of a book on "The Rise of Biology," including both botany and zoölogy, from the earliest times to the beginning of the present century. These three historical works constitute a trilogy of which American biologists may well be proud. He was easily the chief American historian of our science and his eminence in this field was recognized by his choice as the first Chairman of the newly organized Section L on the History of Science in the American Association for the Advancement of Science.

He was also Chairman of Section F (Zoölogy) of the Association in 1913, and the President of the American Society of Zoölogists in 1915. He was a trustee of the Marine Biological Laboratory from 1901 until his death, and in all these capacities he was a genial, broad-minded, judicious colleague and leader. Throughout all his professional life he was, before everything else, a stimulating, inspiring, unsparing teacher and hundreds of his students remember him with reverence and affection.

The American Society of Zoölogists hereby records its sense of loss in his untimely death and extends to his family its sympathy in their bereavement.

E. G. CONKLIN,
C. J. HERRICK.

Minute on the death of Dr. A. D. MacGillivray

Dr. Alexander Dyer MacGillivray, who was long a member of the American Society of Zoölogists, died at Urbana, Illinois, on March 24, 1924.

He was born July 15, 1868, at Inverness, Ohio, and early developed an intense interest in natural history, and especially in entomology. He became broadly acquainted with the insect groups in general and a recognized authority on the taxonomy of the Tenthredinidae. In his later years he was especially interested in the immature stages of insects and in general insect morphology.

It was as a teacher that Dr. MacGillivray's greatest service was rendered. Insistent upon exactness and the utmost attention to detail, he nevertheless won the love and loyalty of a long series of advanced students by his patience, his

painstaking efforts to help, and by his very genuine interest in their welfare. His influence in American entomology will long be felt.

In its desire to recognize the character of Doctor MacGillivray and his services to zoölogy and science, the American Society of Zoölogists places on record this brief testimonial and directs that it be published and a copy sent to the members of the family.

HENRY B. WARD,
W. A. RILEY.

Minute on the death of Dr. George A. Piersol

Dr. George A. Piersol died August 7, 1924, at the age of eighty-six years, after a long and distressing illness. He was a student of Koelliker and Fritsch during the years 1866-88, after which he returned to the University of Pennsylvania to enter upon his long and uninterrupted service in the Department of Anatomy. His interests were in the presentation of his subject as is shown by his books, including the great human anatomy which he published in 1907. This subject is set forth on the basis of original dissections, skillfully reproduced, and accompanied by a text remarkably lucid and complete. His mind was scholarly and this trait entered into both his lectures and his writings. As one of the group of editors who founded *The American Journal of Anatomy*, and as member of the original Advisory Board of *The Wistar Institute*, he was in continuous touch with progress in his chosen field and assisted in the advancement so noticeable during the past twenty years. In the death of Professor Piersol the Society has lost a member of broad interests and scholarly attainments. By this resolution it wishes to record its appreciation of the life and services of Doctor Piersol and to express its sorrow at his passing.

C. E. McCLUNG.

C. E. McClung, President of the Union of American Biological Societies, reported that the Rockefeller Foundation had granted \$350,000 to be used in the next ten years for the inauguration of Biological Abstracts. Not over \$50,000 of this fund is available for any year and only \$20,000 is available for 1925. It is proposed to spend 1925 in organization work which is now estimated to cost \$5000 more than is available from this fund.

The Society voted to give its Executive Committee power to arrange, in cooperation with the treasurer of the Union, for voluntary collections to support the work on Biological Abstracts for 1925. It is understood that the non-duplicating membership list of member societies of the Union of American Biological Societies will be used in this collection. The officers of the Union for 1925 are President, C. E. McClung; Secretary, B. M. Duggar; Treasurer, A. L. Quaintance;

additional members of the Executive Committee, E. W. Allen, C. W. Greene, and I. W. Bailey.

At the request of the Union and on nomination of the Executive Committee of the Society, the following appointments were made for the advisory editorial board of Biological Abstracts:

Taxonomy, H. S. Pratt, G. K. Noble.

General Embryology, D. H. Tennent.

General Physiology, M. H. Jacobs.

On the same nomination, F. R. Lillie and R. G. Harrison were appointed to represent the Society on the council of the Union.

REPORT OF NOMINATING COMMITTEE

The Nominating Committee (Art. III, Sec. 6), composed of George H. Parker, Charles Zeleny, and H. H. Lane, report as follows:

President, one year, C. R. STOCKARD, Cornell Medical School.

Vice-President, one year, C. R. MOORE, Chicago.

Secretary, three years, D. E. MINNICH, Minnesota.

Treasurer, three years, L. B. AREY, Northwestern.

Executive Committee, five years, R. G. HARRISON, Yale.

National Research Council, three years, L. L. WOODRUFF, Yale.

Journal of Morphology, three years (three to be elected), H. B. WARD, Illinois;

F. PAYNE, Indiana; R. W. HEGNER, Hopkins.

Council, A.A.A.S., one year (two to be elected), H. S. JENNINGS, Hopkins;

M. H. JACOBS, Pennsylvania.

Nominations from the floor were called for, but none being presented, the nominations were closed and the above list duly elected.

President Harrison announced the nominating committee for 1925 as: H. S. Jennings, Chairman, Harold Heath and Fernandus Payne.

The Executive Committee recommended and the Society elected twenty-eight active and seventeen associate members, making forty-five new members (see Art. II, Sec. 2).

ACTIVE MEMBERS

- ADELMANN, HOWARD BERNHARDT, A.B., A.M., Ph.D. (Cornell), Instructor in Histology and Embryology, *Stinson Hall, Cornell University, Ithaca, New York.*
- ALLEN, EDGAR, Ph.B., A.M., Ph.D. (Brown), Professor of Anatomy, University of Missouri, *1605 Wilson Avenue, Columbia, Missouri.*
- BARTSCH, PAUL, B.S., M.S., Ph.D. (Iowa), Curator, Division of Molluscs, U. S. National Museum, *Smithsonian Institution, Washington, D. C.*
- CAHN, ALVIN ROBERT, B.S. (Cornell), M.S. (Wisconsin), Ph.D. (Illinois), Instructor in Zoölogy, University of Illinois, *301 Natural History Building, Urbana, Illinois.*
- CARROLL, MITCHEL, B.S., Ph.D. (Pennsylvania), Professor of Biology, *Franklin and Marshall College, Lancaster, Pennsylvania.*
- CHASE, SAMUEL WOOD, A.B. (Bowdoin), A.M., Ph.D. (Harvard), Assistant Professor of Histology and Embryology, Western Reserve University, School of Dentistry; Instructor in Histology and Embryology, *Western Reserve University, School of Medicine, Cleveland, Ohio.*
- DERERER, PAULINE HAMILTON, A.B. (Barnard), A.M., Ph.D. (Columbia), Professor of Zoölogy, *Connecticut College, New London, Connecticut.*
- FISHER, WALTER K., A.B., A.M., Ph.D. (Stanford), Associate Professor of Zoölogy, Stanford University, and Director Hopkins Marine Station, *Hopkins Marine Station, Pacific Grove, California.*
- HAGUE, FLORENCE SANDER, B.A., M.A. (Kansas), Ph.D. (Illinois), Assistant Professor of Zoölogy and Physiology, *Oregon Agricultural College, Corvallis, Oregon.*
- HALL, FRANK GREGORY, B.A. (Milton), M.A., Ph.D. (Wisconsin), Professor of Biology, *Milton College, Milton, Wisconsin.*
- HARRIS, REGINALD GORDON, Ph.B., M.A. (Brown), Ph.D. (Uni. de Paris), Director Biological Laboratory, *Cold Spring Harbor, Long Island.*
- HINRICHS, MARIE AGNES, A.B. (Lake Forest), Ph.D. (Chicago), Fellow, National Research Council, *Department of Physiology, University of Chicago, Chicago, Illinois.*
- HIRASAKA, KYOSUKA, Rigakushi (The graduate of the Faculty of Science, Tokyo Imperial University), Professor of Zoölogy in Dai Hachi Koto Gakko, *No. 109, Higashi Kurumamichi 7 chome, Nagoya, Japan.*
- HISAW, FREDERICK L., A.B., B.S., A.M. (Missouri), Ph.D. (Wisconsin), Assistant Professor of Zoölogy, *Biology Building, University of Wisconsin, Madison, Wisconsin.*
- HOADLEY, LEIGH, A.B. (Michigan), Ph.D. (Chicago), National Research Council Fellow in Zoölogy, *Department of Zoölogy, University of Chicago, Chicago, Illinois.*
- HUESTIS, RALPH RUSKIN, B.S.A. (McGill), M.S., Ph.D. (California), Assistant Professor of Zoölogy, *University of Oregon, Eugene, Oregon.*
- JOHNSON, GEORGE EDWIN, B.S. (Dakota Wesleyan), M.S. (Chicago), Ph.D. (Harvard), Associate Professor of Zoölogy and Experiment Station Mammalogist, *Kansas State Agricultural College, Manhattan, Kansas.*
- JONES, SARAH VAN HOUSEN, Ph.B. (Chicago), M.S., Ph.D. (Wisconsin), *Rochester, Michigan.*

- KING, ROBERT L., A.B., Ph.D. (Pennsylvania), Instructor in Zoölogy, *University of Pennsylvania, Philadelphia, Pennsylvania.*
- LANDAUER, WALTER, Dr.Phil.Nat. (Heidelberg), Fellow in Genetics, *Storrs Agricultural Experiment Station, Storrs, Connecticut.*
- MILLER, ROBERT CUNNINGHAM, A.B. (Greenville), M.A., Ph.D. (California), Assistant Professor of Zoölogy, *University of Washington, Seattle, Washington.*
- OBRESHKOVE, VASIL, B.S., M.S. (Syracuse), Ph.D. (Harvard), Assistant Professor of Zoölogy, *Syracuse University, Syracuse, New York.*
- OSLUND, ROBERT M., B.A. (Montana), Ph.D. (Chicago), Instructor in Physiology, *Vanderbilt Medical School, Nashville, Tennessee.*
- SCHWITALLA, S. J., ALPHONSE M., A.B. (St. Louis), A.M., Ph.D. (Johns Hopkins), Associate Professor of Biology and Regent St. Louis University School of Medicine, *St. Louis University, 1402 South Grand Avenue, St. Louis, Missouri.*
- SCOTT, JOSEPH MEHOLLIN, S.B. (Mt. Union), D.Sc. (Johns Hopkins), Dr. M. J. Lichty Professor of Biology, Mount Union College, *141 Simpson Street, Alliance, Ohio.*
- SHANER, RALPH FAUST, Ph.B. (Lafayette), Ph.D. (Harvard), Associate Professor of Anatomy, *University of Alberta, Edmonton, Alberta, Canada.*
- STOLL, NORMAN RUDOLPH, B.S. (Mt. Union), M.S. (Michigan), Sc.D. (Johns Hopkins), *310 West Monument Street, Baltimore, Maryland.*
- VISSCHER, JOHN PAUL, A.B. (Hope), A.M., Ph.D. (Johns Hopkins), Assistant Professor of Biology, *Western Reserve University, Cleveland, Ohio.*

ASSOCIATE MEMBERS

- BALL, RUTH JANE, B.S., M.S. (Vermont), Assistant Professor of Zoölogy, *University of Vermont, 74 Buell Street, Burlington, Vermont.*
- BALL, GORDON HAROLD, B.S., M.S. (Pittsburgh), Ph.D. (California), Instructor in Zoölogy, *Southern Branch of the University of California, Los Angeles, California.*
- BANGHAM, RALPH VANDEVORT, A.B. (Wilmington), B.S., A.M. (Haverford), Ph.D. (Ohio State University), Professor of Biology, *Wooster College, Wooster, Ohio.*
- BISSONNETTE, THOMAS HUME, M.A. (Queen's), Ph.D. (Chicago), Professor and Head of Zoölogy Department, *Coe College, Cedar Rapids, Iowa.*
- BRAUER, ALFRED, A.B. (Kansas), M.A., Instructor in Zoölogy, *University of Kentucky, Lexington, Kentucky.*
- COLE, ELBERT CHARLES, A.B. (Middlebury), A.M. (Trinity College), Ph.D. (Harvard), Assistant Professor of Biology, *Williams College, Williamstown, Massachusetts.*
- EDDY, MILTON W., B.S., M.S. (Northwestern), Associate Professor of Biology, *Dickinson College, 249 West Louther Street, Carlisle, Pennsylvania.*
- GATES, WILLIAM HAZEN, A.B. (Williams), Professor of Zoölogy and Head of the Department of Zoölogy and Entomology, *Louisiana State University, Baton Rouge, Louisiana.*
- HALL, RICHARD PINKHAM, A.B. (Henderson-Brown), M.A., Ph.D. (California), Instructor in Biology, *The Rice Institute, Houston, Texas.*

- HOLMQUIST, ALBERT MARTINIUS, B.A. (St. Olaf), M.S. (Chicago), Instructor in Zoölogy, St. Olaf College (on leave), Assistant, *Zoölogy Department, University of Chicago, Chicago, Illinois.*
- LAZIER, EDGAR LOCKE, A.B., M.A. (California), Instructor in Biology, *Reed College, Portland, Oregon.*
- LINEBURG, BRUCE, A.B. (Ohio University), A.M., Ph.D. (Johns Hopkins), Head of Department of Biology, *Lake Forest College, Lake Forest, Illinois.*
- MAY, RAOUL MICHEL, A.B. (Leland Stanford Jr.), A.M., Ph.D. (Harvard), 1924-25 holder of a fellowship of Harvard University for study in Europe, especially France, *Zoölogical Laboratory, Harvard University, Cambridge, Massachusetts.*
- ORR, PAUL RUDBERT, B.S. (Muhlenburg), M.S. (Pennsylvania), Instructor in Zoölogy, University of Pennsylvania, *213 N. Thirty-fifth Street, Philadelphia, Pennsylvania.*
- ROXAS, HILARIO A., B.A., B.S. (Philippines), Instructor in Zoölogy, University of the Philippines; Fellow, University of the Philippines; Fellow, University of Chicago, *5635 Drexel Avenue, Chicago, Illinois.*
- SHAFTESBURY, ARCHIE D., A.B. (Southwestern), Asst. Professor of Zoölogy, *North Carolina College for Women, Greensboro, North Carolina.*
- WILSON, IRA TEMPLIN, A.B., A.M., Ph.D. (Indiana), Professor of Zoölogy, *Heidelberg College, Tiffin, Ohio.*

MISCELLANEOUS RESOLUTIONS

During the year the approval of the Society was asked for a projected survey of the ocean bottom by means of newly perfected sounding instruments to be carried on under the auspices of the United States Navy. The Executive Committee recommended the following resolution on this matter:

Resolved, That the American Society of Zoölogists considers that a survey of the ocean bottom as proposed by the United States Navy is highly desirable, provided the general scientific program is agreed upon by the naval authorities in conjunction with the National Research Council.

Concerning Conservation of Wild Life, presented by L. J. Cole:

WHEREAS, The Migratory Bird Treaty Act of 1918 has already markedly increased bird life throughout the United States and Canada, notwithstanding the slender appropriations for its enforcement; and

WHEREAS, These benefits have recently been lessened by private and public drainage operations, often ill-advised and futile, and are seriously threatened by the activities of drainage companies soliciting business regardless of the value to agriculture of the lands they seek to drain; and

WHEREAS, Legislation is now pending for saving by purchase, without cost to the general tax-payers, many breeding and feeding grounds of aquatic birds for administration by the Department of Agriculture, and for raising a fund, without cost to the general tax-payers, for the better enforcement of the Migratory Bird Treaty Act; be it

Resolved, That the American Society of Zoölogists regards this legislation of the greatest conservational value because designed to save from destruction on a great scale not only water fowl and other migratory birds, but fur-bearing animals and fishes also, perhaps even to save many American species from extinction.

Concerning Water Pollution by Oil Wastes, presented by
C. B. Davenport:

WHEREAS, In spite of the beneficial legislation enacted by Congress as the "Oil Pollution Act of 1924," oil from refineries, ship repair yards, oil supply tanks, and similar sources is a serious menace, both economic, aesthetic, and sanitary, to our public waters, and threatens our natural fauna of fish and other aquatic life;

Resolved, By the American Society of Zoölogists that this Association urges upon Congress and particularly upon every State the necessity of immediate and wise action to conserve the public and private interests in our lakes, main water courses, harbors, and shore lines.

These three resolutions were adopted without adverse comment or negative votes.

An invitation to participate in the Thomas Jefferson Centennial celebration was presented. The Secretary was instructed to acknowledge its receipt with thanks. A resolution concerning adherence to the World Court was not acted upon, since it was thought to lie outside the scope of the organization.

The Secretary presented an invitation from the Yale Corporation to hold the next annual meeting at New Haven in connection with the dedication exercises of the Peabody Museum. Other invitations from different cities were also presented. There was also the annual question concerning continued meeting with the American Association which will meet in Kansas City in 1925. After discussion it was voted to hold the next meetings in New Haven, but to extend the same abstract publication facilities to members of the Society or of the Genetics Sections desiring to present or introduce papers at Kansas City as at New Haven. It was the understanding that the Kansas City program would be held under the direction of the officers of Section F. The incoming Secretary was instructed to take up with the Botanical Society of America and with the Genetics Sections the whole question of meeting places as related especially to the meeting of joint sections.

THE JOURNAL SITUATION

At the Boston meeting of the American Society of Zoölogists, December, 1922, a committee was appointed to adjust the relations of the Society to The Wistar Institute. The action was to give "power to make all temporary arrangements and negotiations necessary to continue publication, up to the point of final commitment of the Society to new policies." It was the understanding of the committee that arrangements were to be made with The Wistar Institute, without altering the dues. The committee determined as well as it could in a limited time the various desires of Society members, submitted these to The Wistar Institute, and secured a series of options which met these desires. The report of the committee was submitted to the officers of the Society, and subsequently put into effect by The Wistar Institute.

At the Cincinnati meeting, December, 1923, a report was made upon the publication situation, and after an extended discussion it was decided to make no change in the plan of subscriptions for the coming year. In order, however, to improve matters whenever opportunity offered it was "Resolved: That we commit to the Editorial Board of the Journal of Morphology the further duty of consulting with The Wistar Institute, and with other biological societies interested, in regard to the whole subject of biological publications, and especially The Wistar Institute's service to biology and to the societies in their publications: That the Executive Committee of the Society be empowered to act for the Society in these matters during the year 1924."

Upon presentation of this action to Doctor Greenman, arrangements were made to have a discussion of the problem by the Advisory Board of The Wistar Institute, and the newly elected members of the Editorial Board of the Journal of Morphology. At this conference, which was held on April 21st, there were present Dr. R. G. Harrison, President of the Society, Doctors King, Mast, Schaeffer, and McClung, of the Editorial Board, and Doctors Barker, Gage, Donaldson, Conklin, Huber, McMurich, and Greenman, of the Advisory Board of The Wistar Institute. On this occasion a full discussion of publication problems from the standpoint of author and publisher was had, and there resulted the following actions:

1. *To meet the widely expressed desire that the publication, for which the Society is editorially responsible, should be representative of the interests of its members, it was voted to recommend to The Wistar Institute that the name be changed to the "Journal of Morphology and Physiology."* Construed broadly, such a title would permit the entry of all worthy articles except those of a purely taxonomic nature.

2. *To secure a more reasonable distribution of material, according to subject and scope of each journal, it was provided that there be held a conference of representatives from the Editorial Boards of the journals published by The Wistar Institute, and, if possible, from other biological journals.*

- Finally, 3, *it was recommended that a referendum be taken to determine if the members of the Society desire to be released from a fixed obligation in support of publications as a part of the annual dues.* Doctor Greenman stated that The Wistar Institute greatly appreciated the assured support which the Society had provided in this way, during a period of great uncertainty, but that he thought it would be in a position by the end of the year to face the risk of further deficits

alone. The Society may, therefore, withdraw from the present arrangement if it desires without seeming to disregard an obligation to share in the financial losses incurred in publishing the results of its scientific work. It must be fully realized, however, that the amount and character of biological publication will remain directly proportional to the financial support given by members of the Society to The Wistar Institute in subscriptions, either for journals or for separate articles. It is, therefore, hoped that, if the Society decides to abandon the present method of journal support, its members will be even more generous in subscriptions than in the past. Only in this way, at least at present, can adequate publication facilities be secured.

The alternative to the present series of options with a fixed contribution, which The Wistar Institute is prepared to offer, is as follows:

To properly accredited members of the American Society of Zoölogists journals will be supplied at the following rates:

		<i>Regular price</i>
Journal of Morphology,	\$7.50 per volume of 600 pages	\$12.00
The Journal of Comparative Neurology,	5.50 per volume of 500 pages	7.50
The American Journal of Anatomy,	5.50 per volume of 500 pages	7.50
The Anatomical Record,	3.75 per volume of 400 pages	5.00
The Journal of Experimental Zoölogy,	5.50 per volume of 500 pages	7.50

DISCOUNTS

Members subscribing to more than one journal during one year will be allowed discounts as follows:

- When subscribing to 2 journals, 5 per cent discount
- When subscribing to 3 journals, 10 per cent discount
- When subscribing to 4 journals, 15 per cent discount
- When subscribing to 5 journals, 20 per cent discount

Separate articles, bound in heavy, durable paper covers, will be supplied at the rate of \$10.00 per 1000 pages when supplied from the journal issues of the current calendar year. Such separate articles should be selected by consulting the Advance Abstract Sheets. No rebate or allowance can be made if the full quota of 1000 pages is not secured during the year.

Of all members of the American Society of Zoölogists who have made selections from the several options offered during 1924, more than one-half have selected separate articles. This would seem to indicate a growing demand for this form of zoölogical literature.

One of the chief difficulties, however, of furnishing separate papers at reasonable prices comes from the practice, followed by some authors, of distributing large numbers of reprints. This practice also affects the price of journals, since, as in the case of reprints, it limits sales, and as a result the prices must remain high in order to maintain sufficient income. Even at best the income of each journal must be supplemented by a generous contribution each year.

The report of this special committee was submitted to all members of the Society in September together with a referendum ballot. Seventy-eight members voted in favor of separating dues from the support of journals, while seventy-two voted in favor of a continuation of the present policy. The Executive Committee, after reviewing this vote, together with the number of resignations on hand and pending, brought in a recommendation favoring the adoption of the so-called 1924 plan which makes journal subscription to the Wistar journals entirely optional, but which secures substantial reductions in subscription price of these journals to members of the Society.

During the discussion, C. E. McClung introduced the appended letter which is published in order to place on record the situation as it exists at present.

PROFESSOR C. E. MCCLUNG,
American Society of Zoölogists, meeting in
Washington, D. C., December 29, 1924.

MY DEAR PROFESSOR MCCLUNG:

The following statement relating to the publication of journals by The Wistar Institute is presented for the information of the American Society of Zoölogists.

The establishment of The Wistar Institute Press has made the following accomplishments possible:

a. To publish all papers in custody of the Institute, which editors desired to appear in 1924, leaving nothing on hand at the close of the year.

b. To print and distribute all issues of all journals due in 1924 before the close of that year. Some numbers were printed fifteen to twenty days in advance. This has never been accomplished before.

c. To furnish cleaner proofs.

d. To make last-minute alterations and corrections for authors that have never before been possible.

e. To print the same number of pages for approximately 22 per cent less expenditure of funds.

These results are about what were expected.

One of the unexpected advantages, however, of having a press equipment at our command is the facility by which illustrations may be brought to maximum perfection with the engravings at hand and typographical adjustments readily made to suit the author.

Under the present plan, whereby \$6.50 of each member's dues in the American Society of Zoölogists is paid to The Wistar Institute for journals, under certain options, the income from your Society for journals during 1924 was as follows:

Dues from 346 members	\$2251.00
Subscriptions to issues or reprints not covered by the membership dues	2310.81
Total	\$4561.81

Income during 1923:

Dues from 360 members	\$2305.00
Subscriptions to issues not covered by dues.....	1482.86
Total	\$3787.86
Increase in 1924 over 1923, \$773.95.	

This method of support appears to be somewhat more advantageous than the method followed by the American Association of Anatomists, where no dues are contributed to journal support, but where members purchase such as they desire at 75 per cent of the published price.

American Association of Anatomists

During 1923, of a membership list of 432, 409 contributed to the support of journals at the rate of \$6.50 per member.....	\$2658.50
and subscribed to issues not covered by dues amounting to.....	1088.28

Total	\$3746.78
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During 1924, when the American Association of Anatomists contributed no dues to the support of journals, with a membership list of 437, 191 members subscribed to journals at 75 per cent of the published price, giving an income of.....	\$3348.42
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A decrease of contribution in 1924 of	\$ 398.36
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On accompanying sheets I am presenting the details of journal support under the two methods.

In examining the statement pertaining to the income derived from the American Society of Zoölogists, it will be observed that 137 members subscribe to issues, not covered by dues, according to Option A, Option 1, and Option 2. These three options relate to completed issues or numbers of the journals, and the extra income derived from subscriptions under these options amounts to \$2077.80. One hundred and eighty-six members subscribe according to Options 3 and 4; these options relate to the supply of reprints, and the extra income derived under these options amounts to \$233.01. It is thus apparent that while the greater number of members (186) take reprints, the lesser number of members (137) supply the greater extra income.

Experience thus far appears to indicate that if the reprint plan of distribution should continue to grow in favor, it will be necessary to compensate for lack of income by a readjustment of price, by an increase of dues, by increasing the sale of reprints, or by some other means. At the present time it is possible to continue this method of distributing separates because of the fixed contribution made by each member of the Society.

The unfortunate feature of this arrangement, from the accounting viewpoint, is that it costs approximately \$800 more to handle the reprint subscriptions than it does to care for the regular subscriptions to complete numbers or volumes. For this reason we are compelled to ask that Option no. 3 (taken by thirty-six members), under which reprints are sent according to the classification numbers

selected, be eliminated and simplify the problem somewhat by supplying all reprints under Option no. 4, where reprints are selected after consulting the advance abstracts. This will give some relief in the publication office.

It is understood of course that the Society may decide to abandon the present method of securing journals for its members' and accept the plan designated on your notice to members as the 1924 Plan.

The Wistar Institute stands ready to continue the present arrangement or accept the 1924 Plan if the Society so prefers. It is our impression, however, that the present arrangement will be most satisfactory.

In establishing a Press The Wistar Institute makes a substantial annual contribution to the publication of zoölogical research, and it is hoped that no excessive deficits may be incurred in the future. The one problem which offers serious difficulties in publication work is the problem of furnishing adequate illustrations. At the present time, little is attempted beyond that which can be produced by the less expensive photographic processes. Quite frequently a paper requires heliotype or lithography. It is hoped that some assistance may soon be secured to overcome this difficulty.

In conclusion, may I ask that you kindly express to the American Society of Zoölogists the appreciation of The Wistar Institute of the cordial and generous cooperation which has always been rendered by your Society.

Very sincerely yours,

M. J. GREENMAN, *Director.*

AMERICAN SOCIETY OF ZOÖLOGISTS

DECEMBER 27, 1924.

1923	Dues received for 360 members amounting to.....	\$2305.00	
	Subscriptions to extra issues.....	1482.86	
			\$3787.86
1924	Dues received for 346 members amounting to.....		\$2251.00
	Subscriptions to extra issues (issues not covered by membership dues):		
	<i>No. subscriptions</i>		
Option A...	24 ...Morphology	\$108.59	
	Neurology	107.59	
	Anatomy	128.99	
	Record	124.17	
	Zoölogy	155.86	
			\$625.20
Option 1...	56 ...Morphology	\$165.70	
	Neurology	54.95	
	Anatomy	186.97	
	Record	279.13	
	Zoölogy	187.33	
			874.08

Option 2...	57	...Morphology	\$207.05	
	—	Neurology	82.09	
	137	Anatomy	97.17	
		Record	103.98	
		Zoölogy	88.23	
				578.52
				2077.80
Option 3...	36	...Morphology	\$ 24.31	
		Neurology	4.12	
		Anatomy	17.68	
		Record	6.65	
		Zoölogy	31.14	
				\$ 83.90
Option 4...	150	...Morphology	\$ 34.35	
	—	Neurology	15.16	
	186	Anatomy	20.64	
		Record	9.37	
		Zoölogy	69.59	
				\$149.11
				233.01
		Total		\$4561.81
		Increase over 1923		\$ 773.95
	16	no option selected		
	7	special arrangements		
	346	total		

AMERICAN ASSOCIATION OF ANATOMISTS

DECEMBER 27, 1924.

1923	432 membership list.	
	Dues received for 409 members amounting to.....	\$2658.50
	Subscriptions to extra issues.....	1088.28
	Total for 1923	\$3746.72
1924	437 membership list.	
	No dues received from members.	
	191 members subscribe to the following at the special rate of 75 per cent of the regular subscription price:	
	<i>No. subscriptions</i>	
	Morphology	39
	Neurology	76
	Anatomy	145
	Record	159
	Zoölogy	4
		\$3348.42
	Decrease from 1923	\$398.30

After full discussion, the so-called 1924 plan was adopted by standing vote. This decision separates the support of the Wistar journals from the payment of dues and puts the Society upon a similar basis as the Anatomists with regard to the Wistar publications.

Treasurer Bowen called attention to the diminishing reserve funds and asked that the dues be placed high enough so that the business of the Society could be conducted without too great sacrifice of time and energy on the part of the incoming secretary and treasurer. On his motion, the dues for the coming year were fixed at two dollars.

An invitation from The Wistar Institute to be officially represented at the twentieth anniversary of the organization of its Advisory Board was received, accepted, and the naming of the representative was left in the hands of the newly elected president.

CHANGE IN PROGRAM RULES

In order to avoid the growing congestion of the program at the annual meetings, the program rules found in by-law 7c was changed from—

Papers shall be listed in their respective groups in the order received. When a member offers more than one paper those following the one designated first shall be placed at the end of the list and shall not be read until all first papers by members shall have been twice called for.

to read as follows:

Papers shall be listed in their respective groups in the order received. Each active member is entitled to fifteen minutes of the time of the Society at the annual meeting which he may use to present one or more papers personally or he may use any or all of this time in introducing papers of non-members on the program. The Society recognizes, however, the right of the Genetics Section to make their own program rules in conjunction with the Genetics Section of the Botanical Society of America.

The thanks of the Society were voted to the local committee, particularly to B. H. Ransom, chairman, for arranging the local affairs of the meetings; to R. H. Bowen, for his two years of service as treasurer, and to W. C. Allee, for his work as secretary for six and one-half years.

W. C. ALLEE, *Secretary*.

MINUTES OF THE JOINT GENETICS SECTIONS MEETING AT
WASHINGTON, D. C., DECEMBER 29-31, 1924

Sessions for the reading of papers were held Monday afternoon and Tuesday and Wednesday mornings. Dr. W. E. Castle, Chairman, presided at all sessions, except part of the Monday afternoon session, when Dr. G. H. Shull was asked to preside.

Twenty-two papers on botanical subjects and twenty-nine on zoölogical subjects were presented. The following officers were nominated and elected for 1925.

Chairman, H. H. BARTLETT.

Society Representative, R. K. NABOURS.

Secretary-Treasurer, D. F. JONES.

Representative on Board of Control of Botanical Abstracts, H. J. MULLER.

Representative on Editorial Board of the Journal of Heredity, L. C. DUNN.

A committee to act with the Publication Committee of the Biological Abstracts was appointed as follows:

Sewall Wright

R. A. Brink

H. J. Muller

E. W. Sinnott

A member to act on the Committee of Arrangements of the International Association of Plant Sciences was requested. C. E. Allen was appointed.

In view of the fact that the Secretary has received the funds collected as dues from the members, it was moved and carried that—

“The office of Secretary be changed to Secretary and Treasurer.”

In view of the increasing number of papers on the program, it was moved and carried that—

“No one shall be permitted to present more than one paper until all others on the program shall have been called. All additional papers shall be placed at the end of the session's program and presented if there is time. If not, they shall not be carried over to the following sessions.”

The average attendance was about 150.

MEMBERS OF GENETICS SECTION

ALLEN, EZRA

BAITSELL, GEORGE ALFRED

BANTA, ARTHUR MANGUN

BIGELOW, MAURICE ALPHEUS

BORING, ALICE MIDDLETON

BRUNER, HENRY LANE

CAROTHERS, E. ELEANOR
CASTLE, WILLIAM E.
CHESTER, WAYLAND MORGAN
COLE, LEON J.
COLLETT, MARY ELIZABETH
COLTON, HAROLD SELLERS
CRAMPTON, HENRY EDWARD
CURTIS, WINTERTON CONWAY
DAVENPORT, CHARLES BENEDICT
DAWSON, JAMES ARTHUR
DETLEFSEN, JOHN A
DUNN, LESLIE CLARENCE
ELROD, MORTON JOHN
ERDMANN, RHODA
FASTEN, NATHAN
FOX, HENRY
GARMAN, HARRISON
GEROULD, JOHN H.
GOLDFARB, A. J.
GOLDSCHMIDT, RICHARD B.
GOLDSMITH, WILLIAM MARION
GOODALE, HUBERT DANA
GOODRICH, HUBERT BAKER
GRAHAM, JOHN YOUNG
GRIFFIN, LAWRENCE EDMONDS
GUYER, MICHAEL F.
HANCE, R. T.
HANSEN, FRANK BLAIR
HARMON, MARY THERESA
HOLMES, SAMUEL J.
HUNT, HARRISON RANDALL
HUNTER, GEORGE WILLIAM
HUXLEY, JULIAN SORELL
IBSEN, HEMAN L.
JENNINGS, HERBERT S.
JOHANNSSEN, OSKAR AUGUSTUS
JONES, EVA ELIZABETH
JORDAN, HARVEY ERNEST
KINCAID, TREVOR
KING, HELEN DEAN
KIRKHAM, WILLIAM BARRI
KOFROID, CHARLES ATWOOD
KORNHAUSER, SIDNEY I.
KUNTZ, ALBERT
LANCEFELD, DONALD E.
LANDACRE, FRANCIS LEROY
LANE, HENRY HIGGINS

LIPPINCOTT, WILLIAM ADAMS
LUTZ, FRANK E.
MACDOWELL, EDWIN CARLETON
MCCLUNG, C. E.
MCCLURE, CHARLES F. W.
MARK, EDWARD L.
MAYOR, JAMES WATT
MAY, HENRY G.
METZ, CHARLES W.
MIDDLETON, AUSTIN RALPH
MOENKHAUS, WILLIAM J.
MORRILL, ALBRO DAVID
MULLER, HERMAN J.
NABOURS, ROBERT K.
NACHTRIEB, HENRY FRANCIS
NEWMAN, HORATIO HACKETT
OKKELBERG, PETER
OSBORN, HENRY LESLIE
PARKER, GEORGE HOWARD
PAYNE, FERNANDUS
PEARL, RAYMOND
PLOUGH, HAROLD HENRY
RHODES, ROBERT CLINTON
RICHARDS, MILDRED H.
RIDDLE, OSCAR
ROBERTS, ELMER
ROBERTSON, ALBERT DUNCAN
ROBERTSON, W. REES BREBNER
ROGERS, CHARLES GARDNER
ROOT, FRANCIS METCALF
SCHAEFFER, ASA ARTHUR
SHULL, AARON FRANKLIN
STROMSTEN, FRANK ALBERT
STRONG, LEONELL C.
STRONG, REUBEN MYRON
SUMNER, FRANCIS B.
TALIAFERRO, WILLIAM HAY
TURNER, CLARENCE LESTER
WALTER, HERBERT EUGENE
WARREN, DON C.
WHITE, GERTRUDE MAREAN
WHITING, PHINEAS W.
WHITNEY, DAVID DAY
WOLCOTT, ROBERT HENRY
WRIGHT, SEWALL G.
ZELENY, CHARLES

D. F. JONES, *Secretary.*